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FLOODS
IN THE THAMES VALLEY.

Poor naked wretches, wheresoe'r you are,
That 'bide the pelting of this pitiless storm;
How shall your houseless heads and unfed sides,
Your loop'd and window'd raggedness, defend you
From seasons such as these?
—SHAKESPEARE.

TWO PRESSING QUESTIONS OF THE DAY.

BY

FRANCIS INGRAM PALMER, ROYAL NAVY.

ASSOCIATE OF THE INSTITUTION OF CIVIL ENGINEERS.

Late Admiralty Surveyor and Commander of H.M. Indian Government Ironclad, "Magdala."

TWO
2
MAPS

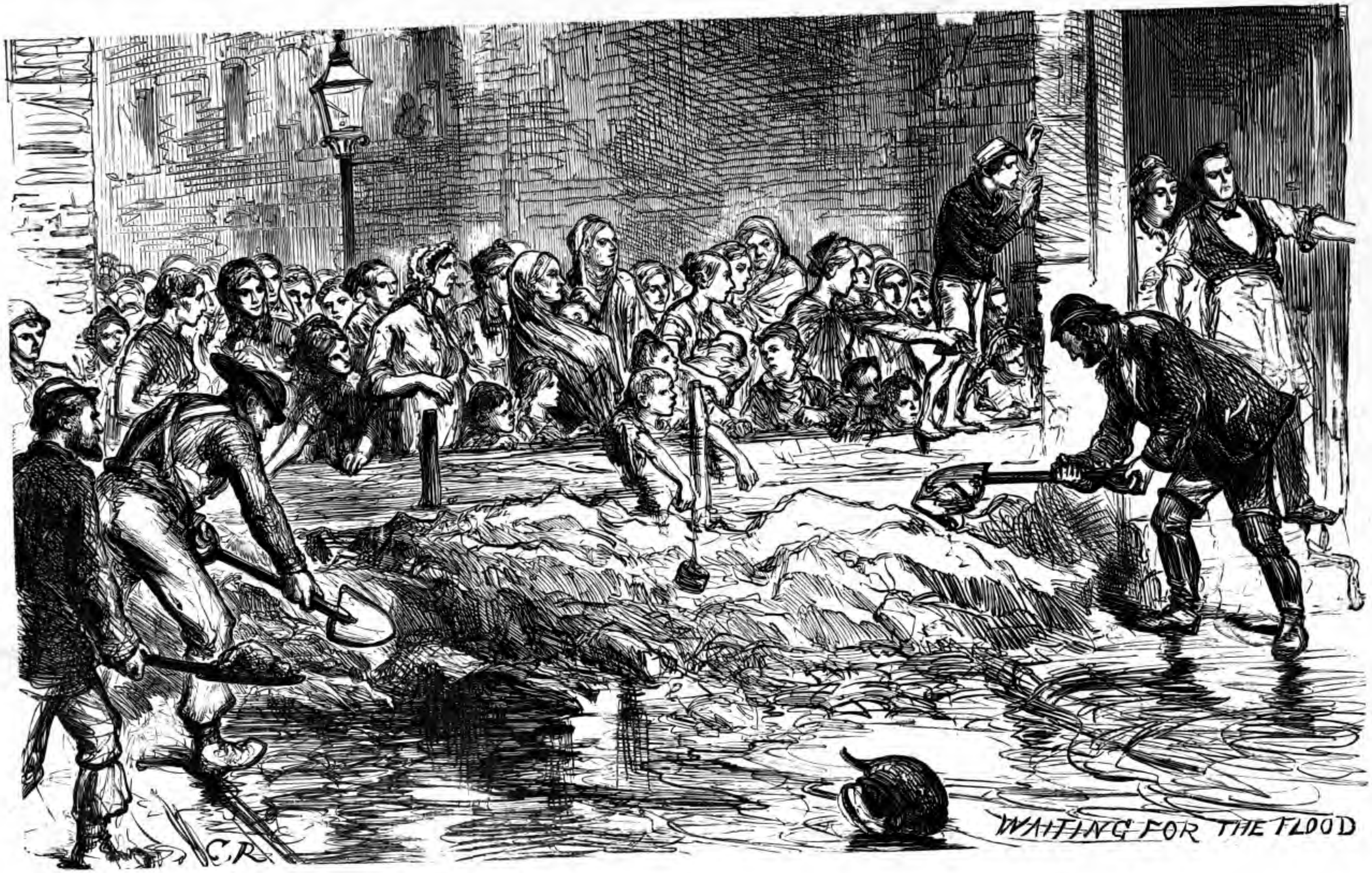
Men do less than they ought,
Unless they do all that they can.
CARLYLE.

EIGHTEEN
18
ILLUSTRATIONS.

THE RELIEF
OF
LONDON BRIDGE
AND ITS APPROACHES.

EDWARD STANFORD, 55, CHARING CROSS, S.W.

PRICE HALF-A-CROWN.



WAITING FOR THE FLOOD

86. h. 84.

FLOODS
IN THE THAMES VALLEY,
AND
THE RELIEF
OF
LONDON BRIDGE
AND ITS APPROACHES.

BY

FRANCIS INGRAM PALMER, Royal Navy,
ASSOCIATE OF THE INSTITUTION OF CIVIL ENGINEERS,
Late Admiralty Surveyor, and Commander of H.M. Indian Government Ironclad "Magdala."

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186. h. 89.

FLOODS

IN THE THAMES VALLEY.

INTRODUCTION.

THE two important questions, which it is the object of this pamphlet to deal with, are nearly allied, inasmuch as both deeply concern the great Metropolis of this country, and affect the beautiful river, which Nature has provided to furnish us with the needful supply of fresh water, a convenient means of carriage and a source of power for manufactures, as well as the most important arterial drain in the country; and which man has done so much to pollute, damage, and disfigure. This is the author's excuse for combining these two questions in one work. But they are so far disconnected that it has appeared advisable to treat them in distinct parts.

For more than a generation these questions have been acquiring an ever increasing importance, and we seem now to have reached the point when serious action has become imperative. The inundations which have lately occurred must be regarded as national disasters. Their result cannot be estimated by the mere loss of so many hundreds of thousands of pounds, but must rather be reckoned by the misery caused to thousands of helpless people, and the prevalence of fevers, rheumatisms, and other diseases with the attendant evils of increased death rates, pauperism, and crime. The characteristic engravings, which have been kindly placed at the author's disposal by the proprietors of the "Illustrated London News" and the "Graphic," and for which he takes this opportunity of expressing his warm acknowledgment, are introduced into this pamphlet to enforce this view and to keep alive the sympathy of the public.

On the other hand, this "Metropolis of the World" has been so rapidly increasing in population and in business, that ready means of communication from one part to the other are an ever growing want. To provide these between the densely populated districts in the East of London on each side of the Thames is the most difficult problem. Many proposals for dealing with it have been lately brought forward, and the City and Municipal authorities have been taking the matter into serious consideration, both generally and with reference to particular projects. One scheme is about to be brought before Parliament by private promoters; but it has not the approval of the Corporation or the Metropolitan Board of Works. These bodies cannot allow private enterprise to create a property in what ought to be and must eventually become a public highway.

In the following pages the author has endeavoured to lay fairly before the public the various proposals which have been made to deal with these questions, subjecting them to such criticism as they appear to deserve, and he has also given his own views and plans for meeting the difficulties of the cases, which are the result of much study and labour. If this pamphlet induces the authorities once more to take up the consideration of these questions, and so lead to the adoption of those measures which shall commend themselves as the best and wisest for present and future probable requirements, his work will not have been in vain.

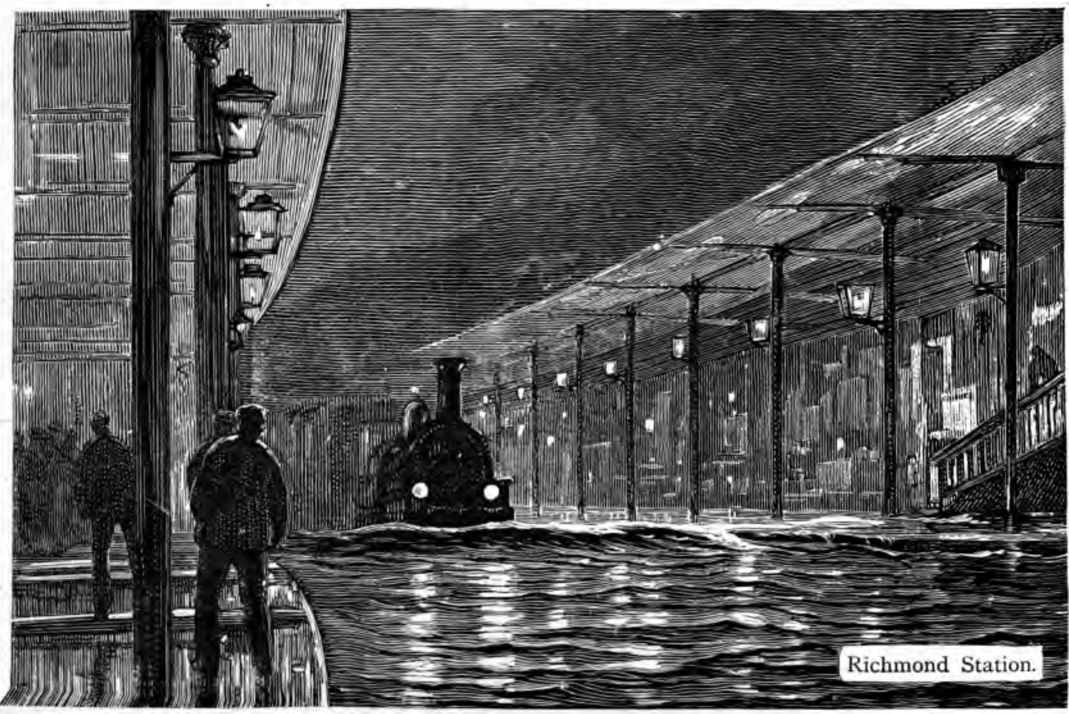
The author has had the advantage of frequent consultations with Mr. James Brunlees, Member of Council Inst. C.E., during the preparation of this pamphlet, and is indebted to that gentleman for much valuable advice and information. Although Mr. Brunlees is in no way responsible for any of the details of this work, the author is authorised to state that on all general points Mr. Brunlees' views are in entire accord with those here set forth.

50, FINSBURY SQUARE, E.C
5th April, 1877.

ERRATA.

Page 14 line 23 for "advantages" read "advantage."
„ 19 „ 15 for "capacity" read "contents."
„ 20 „ 19 for "capacity" read "estuary."
„ 21 „ 12 for "cleanse" read "supply."
„ 24 „ 18 for "suffered from the fertilising properties" read "suffered from the loss of the fertilising properties."
„ 75 „ 18 for "obstructed" read "abstracted."

"COMING OVER."



Richmond Station.

FLOODS IN THE THAMES VALLEY.

THE great personal misery, and loss of property of all kinds caused by the late floods; the damage to health, the effect of which has yet to develop itself; the fear of similar catastrophes in the future, with consequent greater losses, as the river's bank population increases; have most properly aroused the local authorities and riparian owners throughout the length and breadth of the Thames watershed, to combine and to inquire of the Thames River Conservancy Board, the body directly responsible to Parliament, whether they are prepared and able to adopt effectual measures to prevent a recurrence of such disasters.

Looking at the composition of the Board, comprising, as it does, Admiralty Officers, Civil Engineers, and men of letters, gentlemen combining the highest scientific and business talents with an intimate knowledge of the river, the public may rest assured that they are fully alive to the urgency and importance of the case, and are prepared, if greater powers are given to them and adequate funds, to carry out, and that speedily, such suggestions as may commend themselves as proportionate to the interests at stake.

The author hopes in the following pages to make the subject, which has hitherto been seriously discussed among scientific men only, interesting and intelligible to the general public; with the object of strengthening the hands of the authorities in obtaining the requisite powers and raising the necessary money.

In proof that this subject deserves more than passing attention, it must be remembered that,

1stly. Damage to property to the extent of from £300,000 to £400,000, has resulted from the recent floods. A small outlay, would materially, if not entirely, prevent future floodings. Since 1821, four great floods have happened. Presuming, even if it were possible, that the river should continue in the same condition as at present; and even that the old drainage system or rather no drainage of land could be reverted to, there will certainly be four such disasters causing losses equal to the above during the coming 55 years. In round numbers, allowing for the increase of riverside property and population, a dead loss of £2,000,000, without counting loss of life or depreciation of health, will surely follow.

2ndly. Most imperfect land drainage was in force in 1821. Waters which now find their way with a rush into the river, were then, quietly absorbed and stored by the land. A constant and abundant supply of pure water, which was then the exception and not the rule, is now demanded as the first essential to life.

3rdly. The average number of people and the value of the property that suffered from the floods of 1821 and 1852, were only about one-half what they are at the present day. Then, hydraulic and hydrographic engineering were imperfectly understood, all such seemingly complicated works being regarded with a considerable amount of distrust. Now, the country is educated to it, science has moved apace, allowing such operations to be conducted with decidedly beneficial results and to be placed unquestionably under our control.

The Thames Valley has from time immemorial been subject to floods: after extraordinary rains the river channel would become overfull and low-lying lands on either side be submerged. But in recent times these floods have become more frequent and more severe, as well as more general in their effects; not from any increase in the average rainfall, nor that more excessive quantities have fallen in a given time than formerly, but principally because the general adoption of subsoil drainage hurries the water off the land into the river in a very much shorter time, while other causes to which allusion will hereafter be made have also been at work to aggravate the evil. The results of these floods are yearly becoming more disastrous and more severely felt, because the population is constantly increasing,

EMBANKMENTS.

To protect the low-lying lands from being flooded, it has been proposed to raise the banks of the river, and works of this kind have been in many places carried out. Now the effect of such local embankments is most likely to be of serious injury to the river. By diminishing the inundation area, the channel of the river is more heavily charged and the current increased.

So far as we can estimate ancient Thames embankments have robbed the river of over 25 square miles of natural inundation area on the Kent and Essex shores, parts of which are about 10 feet below the highest spring tides; notably the marshes near Barking and Woolwich, which with others used to accommodate some 60,000,000 tons of tidal water; whilst the modern Thames embankments have abstracted an area of nearly five square miles, capable of containing 500,000 tons of water.

The question, therefore, arises whether these embankments have produced any sensible effect on the height of the floods, and also whether

A Workman's Dwelling at Blackwall

it would be desirable to extend them to prevent future inundations. The embankments have in most cases narrowed the channel, but there has not been, so far as is known, any diminution of the volume of tidal water above London Bridge, and there has been produced an acceleration and a prolongation of the tidal action, creating a stronger scour than previously existed. The level of high water along the shores of the Metropolis appears, so far as somewhat imperfect observations indicate, to have been raised 6 inches, attributable to the removal of old London Bridge, the careful deepening of the river by the Thames Conservancy, and the erection of the modern embankments, which combinedly have brought high water throughout the above bridge reach to a more uniform level; and it will be necessary in calculating the height for wharves, &c., along both banks, to provide for this increased height.

Masonry embankments being very costly, earthen embankments have in many parts of the river been raised to protect the lands from floods.

Now, gradient and rate of flow as affecting ordinary earth embankments are powers which deserve serious care. 1 in 1056 or 5 feet in a mile is quite sufficient for scouring purposes.

Water travelling at a velocity of about	⅓	mile per hour, transports	soft clay.
Ditto	⅔	Ditto	ordinary sand.
Ditto	1¼	Ditto	large gravel.
Ditto	2½	Ditto	pebbles as large as hens' eggs,

whilst water travelling 5 miles an hour would create a truly valuable cleansing force if used in the desired direction.

But there were days, during the height of the recent rains, when the flow of water about Teddington and Kew nearly doubled that speed, and the only wonder is that so little damage has been done considering the imperfect embankments which exist in many places.

The erection on the river's bank of unfaced earthen embankments is greatly to be deprecated; for the transporting and abrading power of water is so great, that their use must inevitably tend to raise the river bed and to choke the weirs.

Within tidal limits, and for well-defined reasons, such as the protection of the low-lying lands about Barking Creek and the south side of the Metropolis, embanking is the only available resource, but will be in few cases required to keep out *tidal* waters, if the *land* waters are prevented from accumulating to an unnatural head, by being sent into the estuary during ebb tide to obstruct and cushion back the progress of the returning flood tide.

The Thames Embankment had become a necessity to relieve the enormous and daily increasing traffic between the City and West End, and it is not certain that it has conduced to any appreciable extent to the floodings at Lambeth; but it seems probable that if such embankments were constructed for any considerable length of the Thames' banks, robbing the stream of its natural inundation area, the surface current would be narrowed and our flood difficulties over unembanked areas be made, if possible, worse than at present. Our efforts should, therefore, be to increase, by all reasonable means, both the depth, breadth and straightness in course of the river, and at the same time to provide populous districts such protection as may be required by solid embankments of masonry or concrete. In any case where earth banks are used for protection from flood, they should be at a distance from the river bank beyond the influence of the strong current.

The effect of the land floods co-operating with extraordinary tides to produce floods in the Metropolis, is shown by the following facts:—

TIDAL OBSERVATIONS.

This is a list of the spring tides for the present year calculated to rise above the level of Trinity high water mark:—

Date, 1877.	Height above Trinity High Water.				Date, 1877.
	ft.	in.	ft.	in.	
January 2nd ...	0	6	0	6	July 14th.
February 1st ...	1	2	1	2	August 12th.
March 1st ...	1	8	1	8	September 9th.
March 30th ...	1	3	1	5	October 8th.
			0	6	November 6th.

Mr. Edward Roberts, one of the compilers of the "Admiralty Nautical Almanac," who supplied the above list to the "Times," states that as the remaining spring tides are all below the average, no overflow need be apprehended from them.

To the time of writing this the following has actually taken place at London Bridge:—

		ft.	in.	
On January 2nd	the Tide *rose*	3	11½	above Trinity high water mark.
„ 31st	„	3	4½	„
On February 1st	„	1	11	„
„ 28th	„	2	2½	„
On March 1st	„	2	0	„
„ 15th	„	0	4	„
„ 16th	„	0	1	„
On February 28th	the Tide *fell*	20	9	below Trinity high water mark.

The greatest range or lift of tide has, therefore, been (20 feet 9 inches + 3 feet 11½ inches) = 24 feet 8½ inches; whilst, if we refer back to the extraordinary high tide of 20th March, 1874, which was about 4 feet 4 inches above Trinity high water mark, and to that of the 15th November, 1875, which rose 4 feet 9 inches above Trinity standard, we shall have an extreme range varying from 25 feet 1 inch to 25 feet 6 inches to contend against. The last tides were materially due to exceedingly heavy westerly gales which piled up the Channel waters.

It, therefore, follows, on comparing the foregoing results, that the actual levels of the late tides were—

ft.	in.		
3	5½	higher on	January 2, 1877.
0	9	„	February 1, „
0	4	„	March 1, „

than those calculated upon by Mr. Roberts.

Riparian owners should consequently, if they desire perfect protection, place the entrances to their warehouses and all openings to back riverside property at a minimum height of 5 feet 6 inches above Trinity high water standard.

A comparison of the highest Spring tides between 1833 and 1877 shows that at the entrance to the London Docks they have ranged from 3 to nearly 5 feet higher than at Sheerness, at the entrance of the river, at which latter place the levels almost invariably agree with Admiralty predictions.

		ft.	in.
In 1833	the greatest range of Tides at London was ...	21	8
1843	do. ...	21	5
1873	do. ...	22	6
1874	do. ...	24	11
1875	do. ...	25	6
1876	do. ...	20	9
1877	do. ...	24	8½

The recent inundations about Lambeth, Blackwall, &c., were partly due to the height of the tide and partly to flood land water meeting it, when, owing to the restricted inundation area, they became piled up, and overflowed adjacent low-lying wharves and streets.

The result of five years' observations (1866 to 1870), taken at the upper entrance to the London Docks, shows that the range of the average spring tide has increased at this point from 19 ft. 8 in. in 1842 to 20 ft. 8in. in 1875.

An Admiralty note attached to their Thames River Chart states:—

"It is supposed that this increase in range is attributable to the "removal of obstructions and the extensive dredging of late years in

" the river. From the results of observations made at Sheerness from 1st " January to 31st December, 1867, no material change in the rise of the " tide appears to have taken place in that locality."

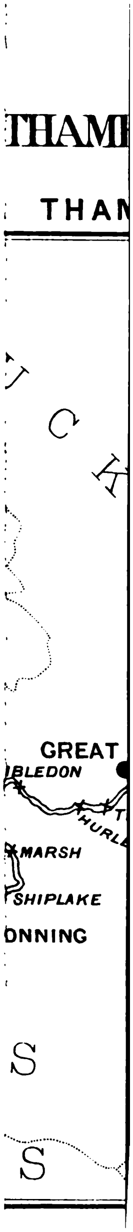
The following Table, abbreviated from Admiralty documents, shows how freely the tide ascends in 1877 as compared with the time when little dredging and fewer lower river improvements were undertaken:—

Date.	London.		Sheerness.		London tides higher.	
	ft.	in.	ft.	in.	ft.	in.
1849	19	9	16	4	3	5
1869	20	6	16	4	4	2
1874	20	9	16	2	4	7
1876	20	8⅞	16	1¼	4	7
1877	20	9	16	2	4	7

As the character of the tides has not materially altered, it, therefore, follows that the improved outfall of the river, the work of the Thames Conservators, has been the cause of the greater heading of water during the past few years about the Metropolis. If these changes can be effected in the face of slight gradients, one may anticipate great benefits if the bed of the upper river be similarly improved. A large discharge of river water at the right moment will certainly offer the most effective barrier to the progress of the tidal wave.

Regarding the rate at which the tide travels, and the time that the tide takes to reach the Metropolis, high water takes place at Sheerness about one hour and a quarter, and at Gravesend about three-quarters of an hour before it is high water at London Bridge, and when high water at London Bridge it is about low water at Teddington, the highest point to which the tide ascends. It is therefore evident that a reflex action takes place before the whole volume of tide has reached the upper limit of its basin. Owing to the river bed having a gradual ascent from the wide portion of the funnel-shaped mouth below Gravesend towards London Bridge, the crest of the tide must advance up the narrows at a proportionately higher speed, which speed is again often assisted by prevalent winds.

As the tidal water is a fairly fixed quantity, whose advent and rate of flow is well anticipated and understood, it should not be difficult, if the plan of regulating the discharge of the land waters is carried out in its integrity, to somewhat thwart the progress of the tide up the river towards London, and at the critical moment to relieve the densely-populated districts of these


THAMI
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excessive river waters, which have hitherto, on meeting the tide, caused such damage.

It may, perhaps, be interesting to compare the results of these ranges of extreme spring tides with the rise of the flood water at Staines, a town many miles beyond the tidal influence, in a neighbourhood where lands have suffered so severely from recent inundations.

The flood-mark near the railway bridge is 40 ft. above Trinity high water mark at Teddington Lock. On November 18th, 1852, the date of the great flood, the water level rose to a height of 6 ft. above this (Staines) mark. Between that date and 1872 it has ranged from 2 ft. 8 in. to 4 ft. 4 in.; whilst in 1875 it reached 5 ft. 8 in.; in 1876, 4 ft. 8 in.; and in 1877, 5 ft. 9 in. above the same flood-mark.

LOCKS, WEIRS, AND CANALS.

For those of our readers unacquainted with the beautiful Thames, it may be well to preface our remarks with some slight description of the river.

It takes its rise in Gloucestershire, about 375 feet above mean sea-level, and from that point to the sea, a distance of 193 miles, runs in a nearly easterly direction, having the counties of Gloucestershire, Oxfordshire, Buckinghamshire, Middlesex and Essex on its left bank, and Wiltshire, Berkshire, Surrey and Kent on the right; all of which counties supply hundreds of feeders, from the tiny rill with its few gallons of water to the impetuous river Cherwell, which, during excessive rains, bears into the Thames, at Oxford, nearly as large a volume of water as flows from the upper basin of the river.

The entire drainage-ground of the river above the tidal flow, an area about one-twelfth the surface of England, is approximately 4,200 square miles, about one-seventh ($\frac{1}{7}$), or 600 square miles of which may be attributed to the upper valley of the Thames above Oxford.

On referring to the accompanying map, reduced from the Ordnance Survey, the length of the Thames from Thames Head, its generally accepted source, to the outer boundary-line of the Thames Conservancy near Southend, measuring the windings of the river, is given as about 193 miles; taking it in a straight line, as the crow flies, it is 119 miles. The tidal influence extends from this outer boundary-line some 57 miles to Teddington Lock, whilst the limits of the river in charge of the Conservancy Board reach from a town called Lechlade, in Gloucestershire, to the already-mentioned boundary-line, a distance of 173 miles or thereabouts—leaving some 20 miles from the river's source to Lechlade outside their immediate supervision.

No opportunity has presented itself of testing the following figures by official documents, but it appears that there are some 34 locks and 29 mills throughout the entire length of the Thames, about nine-tenths ($\frac{9}{10}$) of each being on the seaward side of Oxford,—the mills reaching as far down the river as Chertsey and the locks to Teddington. An average fall of something like 1 foot in 4,100 feet takes place between Oxford and London, whilst in places, especially higher up the river, a fall of 2 feet or more is recorded: gradients well suited to quickly discharge the surplus flood-waters, if assisted, to low-lying levels near the sea.

A first glance at the chart shows three terrible bends, and the more one looks at them and studies their character—the more convinced one becomes of their power to aggravate such floods as have recently occurred. The first is between a point near a village called Tadpole, in Berkshire, and Sutton-Pool, some two miles south of Abingdon; the second is from Reading to the river above Staines; and the third from near Staines to Brentford. By connecting these three points by straight cuts or canals a distance of 16 miles would be saved in the first instance; some 13½ miles in the second; and 11 in the third; the aggregate length of river which would be relieved being 78½ miles as compared with 38 miles of canal, a net saving in distance of 40½ miles.

In the first and second of the above cases, from Tadpole to Sutton-Pool, and from Reading to Staines, it is doubtful whether the country would permit the construction of these cuts at a cost within justifiable limits, and although they would greatly improve the navigation, and would give an increased storage power to the river, the advantages to be derived from them is not so great as might at first sight appear, and they would not be nearly so efficacious as a more extended application of the powers which the several weirs and locks place at our disposal.

But as regards the last named, from Staines to Brentford, or by preference from near Windsor to Brentford, as offering easier country and immediate relief to Windsor, a canal would be of the greatest importance to assist in carrying off, during ebb-tide, waters which must otherwise of necessity be stored in the section of that bight (Windsor to Brentford) during the entire making of the sea-flood.

There are also many smaller bends where the discharge of upland flood-waters could be greatly facilitated by short cuts or canals.

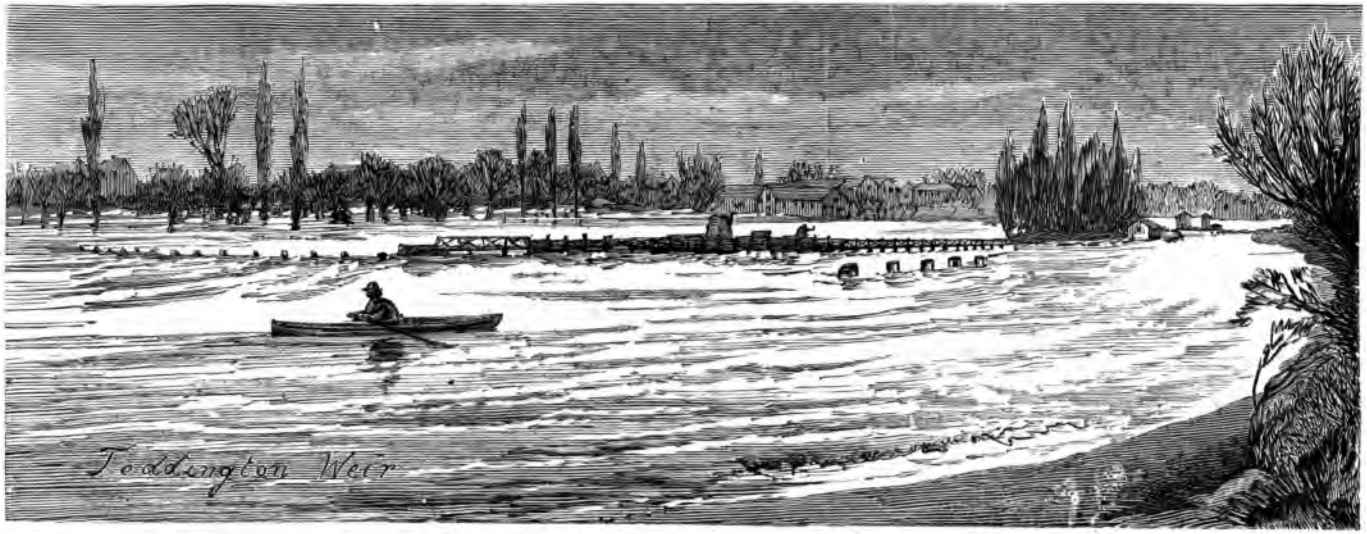
It may be assumed that 7 hours of ebb or discharge water time would generally be available.

A canal with an average breadth of 80 feet and a depth of 12, which last the levels of the country will possibly allow, will, with a 3 mile current hourly discharge

15,206,400 cubic feet,

or during the tide,

106,444,800 cubic feet.



Teddington Weir

Ordinarily, at springs, the ebb tide runs at Brentford nearer 9 than 7 hours, and it may also be assumed that a current of nearer 6 than 3 miles could, if needed for special occasions, be borne through the canal to relieve the river to the extent of 273,715,200 cubic feet—each tide—allowing extra storeroom to that amount to be made available during the three hours of flood tide in the sections between Staines and Teddington Locks.

Extra storeroom is what is really needed in and about the lower reaches of the river, and it is to be regretted that suitable weirs and locks with spacious sluice-gates do not reach as low down the river as Kew, or as the outlet to the suggested Brentford Canal, as in that case the river would be very manageable, and with careful direction, the valuable property about Richmond, Twickenham, Kingston, Hampton Court, Thames Ditton, &c., would be quite protected from inundations.

By this arrangement the tide would not ascend above the lower barrier, wherever it might be placed, whilst it may confidently be asserted that the additional output of river waters at the right moment into the outfall basin, which such a system of storage would permit, would more than retard the advance of the few thousands of tons of tidal waters, which now extend between Brentford and Teddington, and would in addition take themselves away to sea, well beyond valuable city property.

As for removing Teddington, or any of the lower weirs without supplying adequate artificial reservoirs, such a course would naturally invite the free admittance of tidal waters, would retard the downward flow of land waters, and on mingling would place all that reach between Kew and Staines fairly under water, leaving in addition, during ordinary summer months, the same stagnant pool about the lowest barrier, as is now occasionally complained of at Teddington.

RAINFALL.

The amount of rainfall varies; south-westerly winds from the Atlantic being most heavily charged with moisture, and striking first on the Cotswold Hills. For the sake of discussion we may take 25 inches as an average annual Thames Valley rainfall.

An inch in depth of rain is rather more than 100 tons on an acre, consequently on a drainage area of one square mile an inch of rain would give a total of 64,000 tons, a quantity which sometimes falls within a few hours, and which can usually be readily disposed of by the natural water-channels if they have not been tampered with.

OFFICIAL RAINFALL RETURNS.

Compiled at the Meteorological Office.

For December, 1876, *and January*, 1877.

DATES.	LONDON.	OXFORD.	REMARKS.
	in.	in.	
1st week, Dec. 1st. to 8th	1·71	1·82	Although it is true 0·73 in. rain fell at Oxford on Dec. 4th, only 0·22 in. fell at the same place on Dec. 3rd, and 0·07 in., practically no rain, on Dec. 5th; whilst at London 0·22, 0·43 and 0·01 in. fell respectively on the same days. So, to be strictly correct, a mean of 0·58 in. and not 0·73 in. should be adopted. Taking the second excessive rainfall of 0·73 in., which happened in London on Dec. 11th, only 0·02 in. fell on the day preceding, and 0·13 in. on the day following; whilst at Oxford 0·02, 0·44, and possibly 0·13 in. fell on the 10th, 11th, and 12th of December, giving again a mean of 0·58 in. instead of 0·73 in. The greatest rainfall in 24 hours for the month of February, 1877, occurred on the 14th, when 0·41 in. fell both at Oxford and London—the total rainfall for the month, over the valley of the Thames, being 1·96 in., a mean of the two places.
2nd week, Dec. 8th to 15th	0·42	0·66	
3rd week, Dec. 15th to 22nd	1·56	1·06	
4th week, Dec. 22nd to 29th	1·71	0·96	
5th week, Dec. 29th to Jan. 5th	1·35	2·03	
6th week, Jan. 5th to 12th	2·49	1·70	
7th week, Jan. 12th to 19th	0·57	0·61	
8th week, Jan. 19th to 26th	0·25	0·26	
Remaining 6 days, Jan. 26th to 31st	0·50	0·70	
	10·56	9·80	
	9·80		
2)	20·36		

Mean rainfall over the Thames Valley ... ... 10·18 inches, as registered in London and Oxford.

The above Table shows that during the month of December, 1876, about 5·5 inches of rain fell, whilst in January this year 4·7 inches were registered, giving for the two months 10·2 inches, more than two-fifths of the average yearly rainfall. Nearly one-half should have been drained off seaward against exceptionally high spring-tides, to have kept the lands and houses along the river's banks from being flooded.

What happened is known to all. The river at many points became choked, and kept on accumulating those excessive rains, until at last the surplus waters overflowed the banks, doing enormous injury to arable land, grass-land, houses, cottages, manufactories, mills, and the thousands of people living within their reach.

Before discussing the question of capacity it will be well to understand that the diminished rate of evaporation, occasioned by the hygrometric conditions of the atmosphere, exercised a marked influence on the recent floods. During winter evaporation is very feeble and, undoubtedly, during the months of December and January last it was less active than usual; added to which the soil was fairly saturated by November's rainfall, which was somewhat over the monthly average. In this condition 10·18 inches

View from Kingston Bridge

of rain fell in 62 consecutive days, and instead of evaporation disposing about two-thirds, or something like 7 inches, as it usually does, the quantity was probably less than one-third. The volume of the rainfall has therefore in many instances, notably on January 4th, 7th, 8th, 9th, and 11th, for positive want of time to soak into the ground, rather than on the supposition that the underground storage basins could not receive and retain it, been hurried off into the river and the low-lying areas alongside it, causing the disasters under consideration.

The difficulty has to be faced and overcome, and it is useless attributing the disaster solely or even to any great extent to the Thames Embankments, the increased waterway of the London Bridges, the incapacity of the present channel or suchlike causes; although there can be no denying that these structures have probably caused a slight heading of tidal waters above and about the immediate Metropolis; and that the rain-waters have now but little chance of being stored in the soil through the superior systems of under and surface agricultural drainage now in general use.

The problem before us is how to get rid of

Square miles.		Inches.		Feet per mile.
4,200	×	25	×	$5{,}280^2$

= about 243,935,416,667 cubic feet of water in one year,
or an average of only 668,316,210 cubic feet daily.

As regards "*excessive rainfalls,*" July and October may be taken to be the wettest months in England, the former owing to the large amount which falls during thunderstorms and the latter to frequent steady rains; whilst the least fall occurs in April or May. It is well that these heavy rains usually occur on small and comparatively dry tracts of country, and take place at times of the year when the sea tides are probably at their lowest, otherwise the damage, instead of being occasional and partial, would be general and recurring twice or thrice annually.

But, as we have seen, there are times when 10·18 inches of rain (a mean of the Oxford and London rain-guages) are liable to fall in 62 days, as has actually happened, between

1st December, 1876, and 31st January, 1877.

Now 10·18 inches of rainfall over this area

= about 97,600,000,000 cubic feet.

This quantity, allowing fairly for evaporation and the absorbing power of the Thames Valley soil for the above period is, however, susceptible of reduction to

about 65,067,000,000 cubic feet,

which last quantity has to be borne to sea in the short space of 62 days, to keep the lands free from floods; giving an average of 1,049,467,742 cubic feet per day.

The Official Report gives the greatest rainfall in 24 hours at Oxford and London 0·73 in. (4th and 11th January, 1877, respectively).

Accepting this as the greatest rainfall likely to occur in twenty-four hours over the Thames watershed (1·24 in. fell in London on 24th December last, but only 0·37 in. at Oxford),

6,739,200,000 cubic feet

is the quantity we may have to dispose of in one day. This is more than six times the average for the 62 days of excessive rain above-mentioned, and more than ten times the daily average for the year.

OUTFALL AND STORAGE BASINS.

Before going further, it will be as well to ascertain whether the Lower River area, that is the tidal districts, could accommodate and carry off such rains as have lately fallen. Although the tidal influence extends to Teddington Lock, near which place a piling-up of water to something like 11 feet has occurred during the recent floods, to be very prospectively on the safe side, the waterspace should not be regarded as commencing until well clear of the limits of the Metropolis—say as far down the river as Barking Creek, 10¾ miles seaward of London Bridge, or some 25½ miles from the highest point on the river to which the tide ascends. There therefore remain 29 miles of good broad riverway from Barking Creek to the Conservators' outer boundary line near Southend, into which the surplus waters can with safety be discharged. As the length and strength of the tides differ with the several localities, weather and other disturbances, no reliable standard level can be assumed, although for illustration sake a level somewhere above ordinary low-water neap tides, with a uniformly level river floor, has been assumed, on the accompanying table, as being certainly within reliable bounds:—

BIRD'S EY

winter level, with an easy capacity for holding 50 per cent. more on an average depth of say 9 feet, which gives an area of 4,050 square feet at extraordinary floods; and assuming, what generally happens on these occasions, a current of at least seven miles an hour, we arrive at a total outfall of

3,592,512,000 cubic feet per diem.

The river is, therefore, incapable to conduct the great rainfall taken as an example (6;739,200,000 cubic feet) without extra help.*

Help can only be derived from three sources, first the storage capacity of the sections of the river between the locks for the surplus waters during the few hours, or may be one or two days, of exceptional rainfall; second, artificial cuts or canals; and third, artificial storage reservoirs.

The last of these has been and is still frequently advocated, but it is difficult to believe that the impounding and discharging of such enormous quantities as we are dealing with could be satisfactorily managed in artificial reservoirs; even if their enormous cost, estimated by some of our most eminent engineers at £30,000,000, did not preclude their construction.

If the tidal capacity of the river were insufficient to accommodate the upland flood waters, some such artificial storehouses would be needed, but such is not the case, as we have shown.

But their necessity would be entirely negatived, if the various reaches of the Thames, already partial reservoirs, were brought under effective control in the manner about to be suggested. Some slight assistance might occasionally be given by reservoirs, and there can be no doubt that on a few well-selected sites in connection with the proposed canals, which traverse country well removed from the river, they would, for public health and agricultural purposes, be immensely beneficial and eventually remunerative works.

Before the ground became so saturated as to be practically unable to absorb any rainfall, a state that should be well foreseen and guarded against, it would be the clear duty of the Conservancy to run down the basins or sections of the river as low as possible, ready to meet the emergency. Assuming the Table to be fairly correct for the purposes of comparison, we find that by running the river down to an average depth of say one foot of water, we should have reserve room to the extent of about 663,312,672 cubic feet. To this must be added, for at least 90 miles or just one-half of the length of the river where the depths assumed (for ordinary and not for flood-rains) are absurdly too small, quantities to the top of the weir gates, which gates should in our judgment be at least 6 feet, or a height equal to about the natural banks of the basin.

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* This quantity, 6,739,200,000 cubic feet, is founded on a rainfall of 0·73 in. in twenty-four hours—over the entire watershed of the Thames. But if we turn back to the remark column of the Rainfall Table, it will be observed that a considerable reduction, to 0·58 in., has to be made, bringing the net quantity to be dealt with to 5,354,432,876 cubic feet only.

To be on the safe side, only 90 out of 105 miles of the sections are calculated as capable of being made into effective reservoirs at a small expense. This gives an additional capacity of some 975,000,000 cubic feet, which, added to 663,312,672, makes 1,638,312,672; to this add the capacity of the river for flood discharge, 3,592,512,000, and we have 5,230,824,672, against 5,391,360,000, leaving 160,535,328 cubic feet, a quantity easily disposed of by the proposed canal or by reservoirs that might be constructed as additional feeders to our water supplies. Forty years hence the population of the towns along the river's banks will probably be doubled—whilst in London alone some 8,000,000 of thirsty souls will have to be catered for. Allowing the present annual quantity to be 230,000,000 tons, the probable future want with the larger area to cleanse will exceed 500,000,000 tons.

The example in point, although most satisfactorily dealt with, is so exceptional that it would be quite impossible to be so situated if the weather prognostications were attended to; for it must be remembered that the bulk of the soil of the Thames basin has an absorbing capacity of something like 3 inches before reaching a moderate state of saturation, a quantity that would require about four days of an average rainfall of 0·73 in. each, an occurrence that has never been experienced in the history of properly conducted rainfall observations.

An endeavour has been made to show that under proper supervision and suitably assisted, the natural trough of the river is practically able to carry off these very enormous rainfalls, and that no danger on this head or on the capacity of the outfall basin into which these waters are to pass before entering the sea need be anticipated, whilst it may be affirmed that no interests of any importance would be affected.

To clearly demonstrate the practicability of such an arrangement, a Tourists' table has been drawn up giving the approximate capacity of each section of the River Thames during average winter months' rainfall—quantities and levels that need never be exceeded to meet all the requirements of navigation, irrigation, expediency, &c.

A SURVEY AND IMPROVED WEIRS NEEDED.

It has already been stated that some 34 locks and weirs exist on the river; these are all artificial barriers. The weirs are constructed to block the river off into sections, and to retain the waters during dry summer months, whilst the locks afford the means of raising and lowering barge and boat traffic from the level of one section to the next without encountering the several waterfalls and rapid currents of the main stream.

Although the paddles or sluices of these weirs are fitted with a greater or less nicety to discharge the waters, it is obvious that, unless the power is rightly used and held under control by proper machinery, great damage must result.

To insure correct working, the weirs should be strongly built with ample waterway space, and reliable means of working these enlarged sluices, whilst the sills of the weirs should be certainly never higher than the bed of the river, and the tops of the weirs at least as high as the levels of the banks of the sections which they control.

Just now great alteration seems to be needed ; in many places the bed of the river, at any rate near the weir ends, requires deepening, and in certain places widening, whilst the weirs themselves, with few exceptions, need to be strengthened, and to be provided with deeper and higher sluices to assist the passage and storage of flood waters.

If the sills of the weirs were thus altered, the capacity of the river would, both for discharge and storage purposes, be improved, the several feeder watercourses would be facilitated, and the depth of the river would be increased at certain points by scour, reducing, if not entirely obviating, the disastrous effects of the floods, and at the same time furnishing a pure and reliable water supply.

A minute survey is first needed, especially at and about the weirs, before the Engineers can definitely decide the works to be executed and estimate their cost; cross-sections should be taken every fifty feet or less throughout the river's length, and the depths referred to the standard Ordnance datum. At the same time a careful examination for repairs and alterations to locks and weirs must be made.

It will be quite possible, if the survey be at once put in hand, to communicate the results to Parliament by February next year; but if now delayed, a whole year will be lost. Even if this be done, no effectual preventives against the repetition of the late floods can be completed in less than three years. The survey of the upper watershed, undertaken by the Thames Valley Drainage Commissioners, will be a valuable auxiliary.

The suggested river improvements might be effected without the possibility of injury to any particular locality, by simultaneously constructing suitable weirs, locks, and direct canal communication, and would present on their completion a perfect system of communication from which the best results might be anticipated. To rightly work this proposition, a most accurate knowledge of the levels of the entire bed and banks of each of these sections would first be needed, and then the capacity of any section of the river could, on referring to the affixed tide pole, be ascertained to within a few cubic feet.

Having these surveys, the entire river might be placed under a direct telegraph line from its source to the sea, or at any rate as far as the locks extend, each lockkeeper having the power to telegraph the actual levels at either end of his lock whenever required. In fact the river should be under the control of a traffic manager whose duties would be not unlike those of a railway superintendent who has to shunt one train here, stop a second there, and run off so many consecutively down the main line, to

Eton College.

save a block or waste of power and to keep things in working order. This seems to be what the Thames requires, and having it, the manager should, sitting in his office, on referring to a table, be able if he threw in a gallon of water, say at Oxford, to calculate its rate of travel and position at any moment, until it eventually left the river for the sea. This is not a difficult problem, although one requiring very nice working, and it is the only one likely to succeed.

It therefore appears quite feasible by providing workable weirs and a correct telegraphic lock system, also direct communication with certain well established tidal ports on the East and South Coast of England, to keep the river at any desirable height both winter and summer, at for instance such average quantities of water as are shown on the accompanying Tourists' table. There is no risk or speculation in the matter, adequate funds being alone necessary to perfect it; and it may by way of encouragement be stated that such a sum as would provide a harbour of refuge, an ironclad or two, or a well-stocked line of rail would meet the case and give in return perfect house security, increased summer crops, better water supplies, and reliable river traffic, all incalculable benefits. The Thames should, by Act of Parliament, become the property of the Conservators, with a revenue derivable from Water Companies and others who, in summer months, would be glad to purchase water for irrigation purposes. A large sum of money has already been expended in obtaining levels over the higher Thames basin, and many owners can ill understand why they, the unfortunates below the 5 feet contour line, should be taxed something like 3s. 10d. per acre for information which at any rate brings them doubtful immediate advantages. If the proposed improvements are to be made, taxation must be universal, and not local, for all in the watershed, those living on hills as well as those in holes, will in some indirect manner benefit by them; and if a small, an almost invisible, rate for one year were raised on the five or six millions of people living within the basin of the Thames, the matter would be settled for ever.

Although perhaps not a directly imperial question it seems that the Legislature might well assist in the work, for there can be no doubt that most of the dwellings which have been under water will be exceedingly unhealthy for many a long day to come; for when a brick or a stone building gets saturated with water, it is practically impossible to dry it without months of warm air and sunshine, and the result is, and will be, the breeding of fevers, rheumatisms, neuralgia and other ills, that will have to be supported by poor rates and local charities, and although these are not fatal in the strictest sense of the word, they cannot fail to exercise an ultimate effect on the mortality of the districts visited. The fathers of the rising generation of our legislators and leaders have recently drawn attention to this fact when alluding to the unhealthy state in which Eton College must be after the events of the past few months.

Gentlemen interested in the low part of the watershed are naturally anxious that the outlet should be quite efficient, to relieve their lands in the shortest possible time; whilst, on the other hand, the proprietors and others connected with the upper country often hold antagonistic views, desiring the general retention of the waters for cattle and fertilizing purposes. A costly experience of £300,000 or £400,000 now and again should invite both parties to come to a mutual and satisfactory understanding, to speedily decide upon the requisite work, and place the river under a more extensive supervision.

Although fully recognizing the advantages of the much vexed "agricultural drainage," there can be no doubt that it may be and often is, when carried to excess, a source of evil. Now and again, in summer time, there comes a wail of distress about droughts, and the laments are becoming more frequent—droughts, that not only injure cattle and crops, but very directly affect man. Superior drainage has hurried the rains off the lands into the river, causing temporary floods; disasters in their turn, usually followed by half-empty streams, leaving for weeks pools of unwholesome water unfit for drinking purposes. The land has at the same time suffered from the fertilizing properties of the manure, which, instead of remaining in the ground to nourish the crops, have been washed into the drains and thence, as lately experienced at Reading and Oxford, into the river to contaminate the drinking supply.

Now if this superior drainage could be slightly checked during certain weeks of the year; if the rain water was allowed to percolate and find its way into the great subterranean basins which spread over the valley of the Thames, great advantages might be anticipated; for while we advocate the necessity of improving and utilizing the river sections as readily convenient, and as offering the cheapest and most effective remedies, Nature's tanks formed within the chalk and oolite systems should not be forgotten.

The question of larger and more certain water supply, and the purchase of existing water companies, is just now engaging the serious attention of the authorities.

If the measure is passed, it will confer an immense boon on the Metropolis and on the majority of the towns along the Thames, allowing the purity of the water to be increased, whilst it will give the poorer districts a constant and copious supply.

In conclusion, these considerations and the loss to both farmer and labourer from the flooding of the lands must plead an excuse for presenting this pamphlet; the object is to invite useful discussion, and to stimulate hearty co-operation amongst the Local Authorities, who alone by a strong pull together can prevent these annually recurring and almost national disasters.

The evil can be met, and that readily, if the inhabitants of the watershed will combine and provide the sinews of war.

May the perusal of this remind the readers that as time rolls on and delays arise, so will their difficulties grow with an increasing population, and the continually rising price of land.

14th March, 1877.

THAMES CONSERVANCY.

In return to an order of the Honourable the House of Commons, dated 19th February, 1877, the Conservators of the River Thames submit the following in their report:—

" 1. The recent floods in the valley of the Thames having attracted " public attention, and many erroneous statements having been made at " public meetings and in the newspapers, the Conservators of the River " Thames think it right to supplement their annual reports made to " Parliament by the following statement:—

" 2. In considering any question relating to the River Thames a distinction " tion must be drawn between the upper navigation from Staines to " Cricklade, about 40 miles above Oxford, and the lower navigation, extending " tending from Staines to Yantlet Creek. The funds applicable to these " two districts are in a very different condition, the lower fund having been " found sufficient to keep the river in proper order, while that appertaining " taining to the upper district is quite inadequate to complete the reconstruction " struction of the dilapidated locks and weirs, in addition to meeting the " necessary current expenses.

" In 1866 an Act was passed imposing the control of the upper navigation " gation on the Conservators.

" The income of the district thus transferred was barely sufficient to " pay current expenses, nothing being left for works; while the locks and " weirs, with very few exceptions, were in the most deplorable condition, " threatening a total stoppage of the navigation.

" After causing an elaborate survey of the upper district to be made, " and having received reports from the late Mr. Beardmore, C.E., and " Mr. Leach, engineer to the Conservators, the necessary works for maintaining " taining the navigation and for facilitating the escape of flood waters were " steadily carried out.

"6. In 1869 Messrs. Beardmore and Leach prepared a scheme for " improving the river and its branches between King's Weir and Sandford. " ford. Had this scheme been carried out it would have been equivalent to " raising the whole surface of the land subject to inundation in that district " from 2ft. 6in. to 3ft. above its present level, thus securing it against " flooding. The grand advantages offered by this scheme to Oxford and

" to the land in the neighbourhood induced the Conservators to forward a " copy of the Engineer's report to the heads of the colleges at Oxford, to " the Oxford Local Board of Health, and others. The answers received " were favourable to the proposal, and suggested that rating powers should " be obtained for carrying it into effect.

" Unfortunately the riparian landowners strenuously opposed the " rating clauses of the Bill introduced by the Conservators in 1870. These " clauses had to be withdrawn, and consequently the low-lying lands above " and near Oxford are still subject to periodical inundations.

" 8. In 1871 the Thames Valley Drainage Commissioners were constituted under an Act of Parliament for the purpose of draining lands near " the Thames, from Clifton Hampden upwards."

The Conservators then call attention to the fact that " several necessary " works are still unexecuted, for which more money must be borrowed; " but unfortunately the present state of the upper navigation finances " forbids the hope that a sum sufficient to complete these works can be " raised.

" The Conservators have been reproached with neglecting the district " above Oxford, and with spending an undue proportion of their funds in " the district between Oxford and Staines. This reproach is undeserved, " for considerable improvements have been effected between Lechlade and " Oxford. It was of course necessary to apply the chief part of the " resources at the disposal of the Conservators to restoring those locks and " weirs whose failure would have stopped the most important part of the " river navigation.

" 13. Before entering upon the question of floods, a few facts with " reference to the rainfall must be noted.

" The area of the catchment basin of the Thames westward of Kew is " about 3,944 square miles. In the first eight days of last December a continuous rainfall, measuring nearly two inches, saturated the ground; then " followed after a week's dry weather a still heavier fall, which continued with " little intermission until the 19th January. The total rainfall in the seven " weeks ending with this date was about 12 inches; the average annual " rainfall in the Thames Valley being about 25 inches. It will thus be " seen that half the annual average rainfall was poured into the Thames " Valley in seven weeks.

* * * * * *

" As three inches form but a small fraction of the rainfall in December " and January, it is not surprising that an extraordinary flood should have " occurred.

" Only four very high floods—in 1821, 1852, 1875, and early in 1877— " are recorded as having occurred in the Thames Valley during the last " 56 years.

" The records of the flood of 1852 are imperfect, but they show it was " about the same height as the flood of 1877.

The Report then mentions that at the several locks between Staines and Teddington, the level of the great flood of 1821, *exceeded* that of 1877 by heights ranging from 2½ inches to 4 feet, and that whilst the difference of level only ranged from 2½ to 13¼ inches along the upper half of this section of the river, they ranged from 2 feet 3 inches to 4 feet above the level of the recent floods at Sunbury, Moulsey and Teddington. This might and probably would have occurred again if, to use the words of the Report, " the effects of dredging, and likewise the improvements of the " weirs near these latter locks," undertaken by the Conservancy, had not materially facilitated the discharge of upland surplus waters.

Comparing the floods of 1877 with those of 1875 as given in the Report, it is noticeable that the floods of 1875 along the river from Oxford to Staines inclusive, ranged from 1 inch to 15 inches *above* the recent ones; whilst from Staines to Teddington the 1875 floods were *lower* than those of 1877 by from 1½ inch to 3 feet.

" It is now found, as was expected, that the rainfall was less in the " upper part of the river, and very great on the watershed of the rivers " Wey and Mole, causing the marked rise at the three lower locks.

* * * * * *

" The capacity of the river being insufficient to carry off excessive " floods caused by an enormous quantity of rain falling in a comparatively " short time, the water must necessarily spread over the low-lying riparian " districts.

" Although two of these very high floods have succeeded each other in " 1875 and 1876, it has already been stated that only four have occurred in " 56 years.

" 20. The question therefore arises, are these unusual floods sufficiently " frequent, and is the damage caused by them so great as to make it " advisable for the riparian landowners and occupiers, on whom the charge " must necessarily fall, to incur a very large outlay with a view to prevent " the extension, or to mitigate the effects of such floods.

" 21. Various schemes for the prevention of extraordinary floods have " been suggested, among them the construction of impounding reservoirs.

" Let it be assumed that in order to receive only one inch of rainfall " over the 3,944 square miles, forming the catchment basin of the Thames " above Kew, six reservoirs were to be constructed along the course of the " Thames westward of Teddington; if each reservoir were 15 feet deep, it " must be 3¾ square miles in extent. Even supposing the necessary land " could be procured, the cost of this land, and the formation of the reservoirs, would amount to at least a quarter of a million sterling for each " reservoir.

" 22. The alteration of the road-bridges, which are so obstructive to the

" flow of the water, the deepening of the river, lowering of the weirs, and " construction of tumbling bays, on a greater scale than has hitherto been " practicable, would assist the escape of flood waters; but these operations " involve an expenditure beyond the means, and an interference with " private rights beyond the legal powers of the Conservators.

" 23. It is to be hoped that no amount of temporary inconvenience or " damage will induce the Legislature hastily to authorise the construction " of impounding reservoirs, or carrying out other schemes on a large scale " which are certain to be extremely costly, and may not prove effectual " remedies.

" 24. The riparian landowners and occupiers should carefully consider " whether the execution of the extensive works suggested by various " persons may not entail a far heavier burden than any damage caused by " these temporary and rarely recurring floods.

" 25. If excessive floods are to be dealt with a searching preliminary " inquiry should be instituted, for it is manifest that large powers and ample " funds, only to be obtained by an Act of Parliament, must be provided if " all the low-lying lands in the Thames Valley are to be secured against " every possible inundation.

" 26. The improvement of the Upper District, which was transferred in " 1866 to the Conservators in a deplorable condition, has been a source of " constant and anxious consideration, and nothing but the want of adequate " funds has prevented the work of restoration being more speedily and more " completely executed.

" In carrying out all new works, the escape of flood-waters has been " facilitated where practicable, and this important provision will be for the " future, as it has been in the past, duly borne in mind.

* * * * * *

" So far as the recent observations go they prove that the flooding of " the low-lying districts of the Metropolis is chiefly due to very high tides " common to the Thames and to other ports and harbours on the coast, and " not to the embankments or other local causes to which this flooding has " been attributed.

" 28. In conclusion, the Conservators invite comparison between the " present state of the river, whether above or below Staines, with its condi- " tion before their jurisdiction commenced, feeling confident that the more " generally their proceedings are known the more will the public be con- " vinced that the duties imposed on the Conservators have been efficiently " performed."

The Report then states in detail that the Conservators have during their term of office lowered the floors of 9 locks from 6 to 64 inches, averaging 29 inches each; that they have rebuilt and repaired 24 weirs, thereby considerably improving the means for carrying off flood waters, in fact reducing the level of ordinary floods by about 18 inches; and that they have entirely removed 8 weirs in the district westward of Oxford to allow larger waterways.

The conclusion to be drawn from this Report is that the floods can be mitigated if not entirely prevented.

Let us only compare the pleasure of a trip on the River Thames of to-day with that of 15 years ago—then redundant with inconvenience, noisome smells and eyesores—now sweet and clean, with great facilities for landing and passing to and fro, and freely acknowledge that the officers of the Board of Conservancy, considering the inadequate funds at their command and the varied interests they have had to contend against, have carried out all they could possibly have done, and with unspeakable benefit to the citizens of London. Further than that there can be no doubt that they are prepared and willing to place the river under more comprehensive management, provided the necessary funds can be obtained; and, also, that the Conservators will most certainly help others in proportion as the sufferers see fit to help themselves.

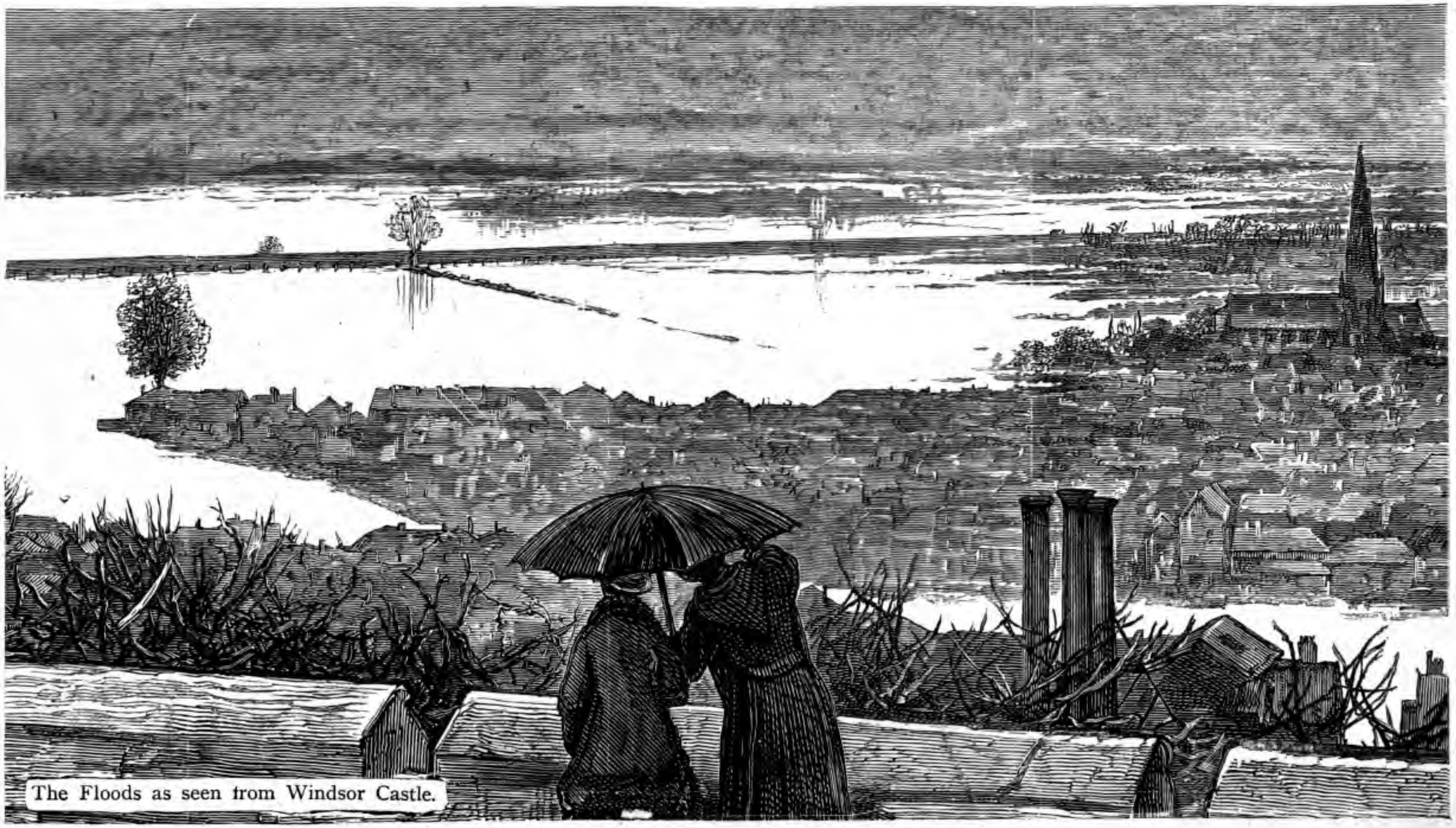
OPINIONS OF THE PRESS.

"THE GRAPHIC," *January 13th*, 1877.

THE FLOODS.—The gradual diminution of woods and copses, the removal of the high, luxuriant, straggling hedges which characterised the days of old-fashioned farming, and the modern system of land-drainage may possibly have had some influence in producing the alternate droughts and floods from which we have suffered for some years past. But it is more probable that such visitations belong to the invariable course of Nature, and it is pretty clear, judging from the meagre revelations afforded by the fly-leaf of a baptismal register, that our forefathers in such seasons as that of 1763-4 suffered quite as severely as we do, though their complaints rarely attained the dignity of print. The question remains as to how far it is possible to abate the mischief caused by these visitations. It may seem almost ludicrous at a time when people have in many places been scarcely able to keep their heads above water, to discuss drought, but it should not be forgotten that drought and flood are cousins who are in the habit of paying us alternate visits. Indeed, country people are well aware that the low-lying level districts, which have for some weeks past been under water, are just those where during such a summer as that of last year cottagers were reduced to the necessity of making their tea from a slender thread of repulsive water trickling along the bed of an almost dry ditch. The whole subject, therefore, deserves to be treated in the most comprehensive fashion, and if our legislators during the ensuing Session of Parliament would devote some considerable portion of their time to it, they would confer a real boon on their constituents. Under the comprehensive head of Water Economy are comprised numerous subsidiary topics, each individually of vast importance, and all more or less intermingled with each other. Among these may be mentioned the deepening and embanking of rivers—especially where they flow by large towns—the formation of reservoirs for village water supply, the provision of means for removing superfluous water from low-lying districts, and the purification of rivers from sewage, and from the refuge of mines and factories. This is a big job, but it would not be beyond the powers of our M.P.'s, if they would determine to spend less time over matters of trivial or ephemeral interest.

"THE ILLUSTRATED LONDON NEWS," *January 13th*, 1877.

THE tidal inundation of the Thames in South London, on the morning of Tuesday week, was a calamity still more deplorable; causing destruction to house and other property to the amount of, it is estimated, half a million of money, and producing great consternation and actual suffering. * * * * * At half-past two in the morning the river began to overflow, simultaneously at all points of its course, and a scene of great excitement ensued. In the Nine Elms district of Lambeth, when the water first made its appearance in the roadways, the police and any persons they could get to assist them commenced a vigorous knocking at all the doors of the houses likely to be flooded, at the same time shouting, "Water's over!"—a cry too well known in the neighbourhood. Within ten minutes, where there had before been not a dozen persons, several thousands were to be seen imperfectly clad, many



The Floods as seen from Windsor Castle.

of them striving to put up barriers at the doors of their houses, or at the entrance to narrow streets, lanes, and alleys. * * * * * On all occasions of flood there is a particular street in this district which suffers more than others—Southampton Street—opposite the good's-yard and below the level of the river. Here the poor people had barely time to get out of the houses when the water rushed in and speedily rose to the ceilings of the first floor. Some persons had moved the little furniture they possessed to more secure quarters, but in most cases their beds and bedding and furniture were destroyed. The houses are now uninhabitable, and must continue so for a long period. * * * * * The tradesmen suffered very heavily, most of the cellars having eight and ten feet of water in them; all sorts of goods were destroyed. * * * * * Along the whole tidal course of the river great misery has been caused, many persons having lost nearly everything they possessed.

"THE GRAPHIC," *January 13th*, 1877.

THE almost incessant rains of last week extended the inundation in the valley of the Thames to a very great extent. At Windsor about three hundred houses in the north-western suburb are flooded. Whole streets, standing nearly a quarter of a mile from the usual course of the Thames, were flooded, the houses rising, as it were, out of a lake. Punts are used as a means of communication. All the necessaries of life have to be conveyed by water to the homes of these poor people. The present inundation is as extensive as the great flood of 1875. The greater part of Oxford Road was flooded, and punts were used between Windsor and Clewer. To travellers coming eastward from the metropolis Windsor Castle, where the Queen and the Princess Beatrice are at present residing, looks like an island, so great an inroad upon the Home Park having been made by the floods. The Mayor of Windsor has formed a committee for the purpose of relieving the sufferers from the inundations, and Her Majesty has sent a donation of £50. On the Eton side of the Thames matters were nearly as bad. Punts navigated the Eton Wick Road, and the traffic between Eton College and Slough was kept open at Willow Brook in a similar way. The water was out extensively near Staines, Thorpe, Chertsey, Bray, Taplow, and Maidenhead, and hundreds of acres of land between Kingston and Richmond were submerged.

"THE GRAPHIC," *January 20th*, 1877.

THE scene depicted on our first page was sketched during the early part of last week before the floods had subsided, as they have now happily done, although as the weather still continues wet it is impossible to say how soon another overflow may be expected. Our engraving shows the comfortless condition to which most of the dwelling houses situated in the neighbourhood of the river were reduced. They are inhabited by the families of working men who are obliged to live near the places where they are employed, and who therefore have not the option of shifting to less dangerous localities. We are glad to see that the fund started by the Lord Mayor of London for the relief of the sufferers is swelling into noble proportions, for there is great need of succour for the poor people whose homes have been soaked, and whose little stocks of furniture and clothing have been more or less ruined by the pitiless flood. The most uncomfortable reflection in connection with the disaster is that it was not merely water which swept day after day through the streets and into the lower parts of the houses, but a dreadful combination of filthy sewage and river mud, some of which has without doubt found its way beneath the flooring of these rooms, and now lies there giving off a deadly poisonous vapour which must sooner or later tell upon the health of the occupants.

"DAILY TELEGRAPH," *February 1st*, 1877.

OVERFLOW OF THE THAMES.—Yesterday morning, and also in the afternoon, the Thames everflowed its banks, though not quite to so serious an extent as in the early part of the month. Notwithstanding the precautions taken at the instance of the Metropolitan Boards of Works by the owners of property, the damage done is considerable. The change in the wind on Tuesday night, when it shifted to north and north-west, gave the inhabitants of the low-lying districts south of the river full warning of what they might expect early in the morning, and the preparations which have been going on for some weeks to resist another invasion of the tide were completed, and in many cases no doubt were successful. The addition to the walls of the London and South-Western Railway Company's premises at Nine Elms saved the Wandsworth-road from another inundation, but in some parts of the same district the water found its way through creeks and docks, and soon reached the houses. Owing to the substantial nature of the barricades erected, comparatively little damage was done. From Woolwich up to Wandsworth the rising tide was watched all the night with anxious interest by those who have been previous sufferers, and it was not till three o'clock that the cry of "Water over!" was again heard. The tide was about eight inches lower than that of January 2, but in the afternoon it rose still higher, and, where property was unprotected, caused much damage. It was high water at London Bridge in the afternoon at 3.36, but long before that time some hundreds of persons had assembled on the embankments to watch the rise of the water, which came up at a rapid rate and ultimately rose about three feet above the Trinity mark. It is stated that no further damage need now be apprehended until the middle of next month.

MR. CLIFFORD TO "WINDSOR AND ETON EXPRESS," *February 3rd*, 1877.

I AGREE with the Rev. C. Wolley-Dod that it is unjust to offer up the Conservancy Board as a scapegoat, considering the many complicated interests, and great difficulties with which they have to contend. They came into office with a bankrupt exchequer, a large, hopeless debt, and many of the locks and embankments in a state bordering on ruin, and the improvements they have effected during their short tenure, in locks, weirs, embankments, and the fishing, with their slender resources, are as much as can reasonably have been expected. * * * The vital question then is as to the remedy. Sir P. Colquhoun says if the flood proceeds from rainfall it is "irremediable." But this is a phrase Englishmen do not understand in the 19th century for any great public evil, and I think it may be shown the case is not so desperate. There is little doubt that drought is a greater evil than floods, and that both subjects must be considered together. Drought will inevitably come, and with the increasing demand of the Metropolis for water, how often shall the world cry shame upon us that this greatest blessing of water which Providence has placed in almost the best position to supply our wants, should be permitted, through our ignorance or supineness, first to operate as a scourge, and then to flow away unused to the sea. The remedy for every branch of the evil is obviously storage, which may be effected as well below the surface as above it, and the only point at which we shrink is the expense, but it has not been sufficiently shown how much may be done to minimise this difficulty. The Parliamentary Committee before referred to, after alluding to the formation of artificial reservoirs for storage in the upper clay-land district, states, that any arrangement would be equally efficient by which the water in the natural subterranean reservoirs could be artificially brought to a lower level before the autumn and winter floods; and that by wells sunk in the oolite down to the floor on which the water rests, a natural reservoir might be made within the mass of rock, which would be available for the reception of much of the flood water which runs to waste, and by pumping from these wells, a discharge could be effected when the springs began to fail, in excess of the amount they ordinarily delivered, so as to reduce the level in the water-bearing stratum sufficient to provide storage for the water floods, and that a similar increase storage could be provided by pumping from wells in the chalk. Sir J. Bazalgette has told us that the necessary works in the tideway can only be effected by the sufferers helping themselves, and we must do the same. If a combined action were taken by all the towns and riparian proprietors down the course of the river and the London Water Companies, with a fair share of help from the Metropolis, the difficulties would shrink into practical dimensions. Mr. Leach, the engineer of the Conservancy, with another eminent engineer, submitted a plan to the Oxford authorities which would have cured the evil in that locality by storage, but which fell through for want of some £30,000. But if Oxford took the initiative, the other towns in the valley, some twenty in number, would soon see the wisdom of following the example in their several localities as far as they were able, and, above all, if the matter were scientifically probed, the Water Companies might find it to their advantage, by deep well-borings in the chalk, to reduce the level of the water bearing and immensely assist in the storage of the floods. A noble example has also been set of what may be done by private proprietors on Mr. Walter's estate at Bearwood, where the water which would run to waste is stored by a dam thrown across a valley, which forms an ornamental lake, supplemented by boring 350 feet down to the chalk to keep up the supply in times of drought, and the water finally serving to drive agricultural and other machinery on the home farm. No doubt there are many similar valley formations in the great watershed where the example might be followed.

But, Sir, these matters are all too grave for inexperts to be meddling in, and I should offer a very humble apology if I had not hopelessly waited to see points I feel to be of so much importance treated by competent authority; but the truth is, there are few subjects on which the public, and especially the riparian mind, needs more to be instructed than the nature and causes of Thames floods, and the application of sound principles on such scientific authority as would leave no doubt how our efforts should be directed. In other words, we require "a platform" and an apostle to lead us, to whom we would say, as heartily as Macbeth :—

> If thou could'st, doctor, cast,
> The water of our land . . . .
> And purge it to a sound and pristine health
> We would applaud thee to the very echo,
> That should applaud again.

I shall be sorry if anything I have here stated should have the effect of discouraging the efforts which are now being made, and which I would do my utmost to further, believing that a strong united action at the present time, if it did not bring a complete remedy for the floods, would at least do a great deal towards rendering them harmless.

SIR P. COLQUHOUN TO "WINDSOR AND ETON EXPRESS," *17th February*, 1877.

THAMES FLOODS.

To the EDITOR of the "WINDSOR AND ETON EXPRESS."

SIR,—I have read with pleasure the exhaustive letter of Mr. Clifford in your impression of the 3rd February; but I would wish to correct a misconception, viz.: that I am represented as saying that flooding from rainfall is "irremediable." Perhaps I expressed myself inadequately. I certainly meant to say that excessive rainfall could not be prevented; not that its *consequences* were "irremediable," for I do not recognise the word "impossible."

In Oriental countries rain is stored in "Bends," and conveyed by aqueducts to the cities or used for irrigation, in summer. The nearest to us are in the neighbourhood of Constantinople, which I have often visited during my residence there.

They are formed by a strong wall across the bottom of a valley, thus creating a large pond, and storing the rainfall from the neighbouring hills. Without these, the country would be parched, and the cities destitute of water. Is this plan inapplicable to the Thames Valley? Could not the drainage be thus stored and utilised? Certainly not; for I observe from Mr. Clifford's able letter that it has already been practised by Mr. Walter, of Bearwood.

I am far from desiring to see the navigable level of the Thames lowered, but I wish to see the sills of weirs lowered and widened, and of better construction, so as to make it possible to drain the Thames to the lowest in anticipation of a flood, which can always be foreseen, and so create storage in the river itself. On the bursting of the Teddington Lock, the water in the Shepperton-Weybridge Valley fell immediately 18 inches. When the Thames was made navigable, pains were taken by the most eminent engineers of the day to restrict its bed by narrowing it and planting oziers to collect alluvium. But since then the destiny of the river has changed; commercial traffic has almost ceased by the competition of railroads, and drainage has increased; the Thames is now required for arterial drainage, and needs widening, not restricting. To lower, however, the navigable level, would be to destroy many water-meadows, and deprive riparian lands of irrigation.

I am far from denying that the Conservancy has executed most useful works in the Upper Thames (between Staines and Oxford), which I visit more than once every summer. Many of the locks and weirs were ruinous and unsafe, and have been gradually improved under the direction of Mr. Stephen Leach, for whose ability I have the highest respect. What is wanted is, first, money; and, secondly, a better representation of the agricultural interests of the Upper Thames.

Now, if the Conservators would join the Riverian Proprietors in an amended Bill, giving power to rate all property within the watershed, and to give extended representation to the agricultural interest up stream, and abate the nuisances and encroachment of mills, and compel the opening and clearing of boundary water-courses, the desired object would be attained.

In conclusion, I observe that the rate levied would be less than the damage caused, and the proprietors be gainers in the end.

I am, Sir, your obedient servant,

Shepperton, 10th February, 1877. P. COLQUHOUN.

"Daily News," *February 19th*, 1877.

A couple of Bills of considerable importance to Londoners have just been introduced into Parliament by Sir James Hogg. The first of these is the promised measure for the prevention of floods, the second is the Bill of which Mr. Alderman McArthur had charge last year for setting the bridges of London free of toll. A good deal of needless blame has been thrown on the Metropolitan Board of Works for not interfering to stop the inundations caused by the late unusual tides in the Thames. There was ample warning fifteen months ago of what has happened this winter, and there is full knowledge now of what may be expected should the spring tides in March be accompanied with strong east winds. The duty of keeping out the tide, however, never belonged to the Metropolitan Board of Works, and that body, which people forget is in no sense a municipal corporation, has no power to cause the necessary works to be done. The engineer of the Board has pointed out that in many cases a very small expenditure would suffice to render a whole district safe; but he can only advise, and the Board cannot give legal force to his advice. The preamble to Sir James Hogg's Bill recites that the Metropolis Local Management Act imposes the duty of raising the wharves and banks and protecting a district from floods on the vestry of the parish or the Local Board of Works of the district. These are the bodies which are really to blame for the late disasters. They have powers to do all the needful works, and divide the cost between the public of the district and the owners of property on the river bank. They have not exercised their powers because of the expense, and they now want to charge the cost on the ratepayers of London. This is the point on which the battle over Sir James Hogg's Bill will turn. Houses have been built, streets made, and wharves opened on land subject to tidal overflow. The owners did not put themselves to the expense of raising their low-lying land, but erected the buildings just as they now stand, subject to floods, and draw large revenues from them. Great damage has been done to their property, much inconvenience has arisen to their tenants, a good deal of public distress has been caused, and the people concerned now demand that Londoners as a whole shall bear the cost of defending the property and making it wholesome and safe. The Metropolitan Board of Works is quite justified in resisting this demand. It asks Parliament, therefore, by this Bill to empower it to insist that the works shall be done by the people who are legally liable to bear the expense, whether local boards, vestries, or private owners. The Board itself and the Thames Conservators are to have power to contribute towards the cost of the necessary works; but the principle of the measure is that the cost of the needful bulwarks against the tide shall be borne by the protected district and the property which needs the safeguard.

"Daily News," *February 19th*, 1877.

Thames Valley Floods.—At noon yesterday a large and influential deputation waited on the Home Secretary, Mr. Cross—the President of the Local Government Board, Mr. Sclater-Booth, being also present—to ask the Government to enquire into and to take some general steps to prevent the serious loss occasioned in the Thames Valley by the disastrous floods that have occurred in such rapid succession. All the towns and local boards of the Upper Thames Valley were represented, and the deputation included 23 members of Parliament.

It was stated that there had been a loss of property in the upper valley of the Thames of from £300,000 to £400,000 occasioned by the floods of the last two years. Another important matter was that these floods polluted the river itself. An Act had been passed to oblige all towns to divert their sewage from the Thames; but all the agriculturalists along the banks used manures of various kinds, which were necessarily carried by the floods into the stream. There were various opinions among the deputation as to whether the investigation asked for should be by a Royal commission or by a select committee of the House of Commons. What they wanted was to discover the cause of the periodical inundations, to have a remedy suggested, and a statement of the means of supplying that remedy.

Mr. Shaw-Lefevre mentioned that the Corporation of Reading has been obliged to execute enormous drainage works by the Thames Navigation Act of 1866, burdening the local rates to the extent of a quarter of a million of money. The floods, however, had overflowed the sewage farm, and carrying out of the sewage works was consequently in a great measure prevented. Sir F. Goldsmid, M.P., having entirely concurred with the remarks of his colleague; Dr. Liddell, the Dean of Christchurch, said that Oxford, on being required to move its sewage from the river, had borrowed £140,000 for the purpose, which he was afraid would be found inadequate. Sir George Bowyer spoke at some length as a riparian landholder, contending that the matter should be dealt with as a whole by the Government, to prevent a burden being cast upon the landholders, which in many cases they were unable to bear. Sir Charles Russell, M.P., and others having spoken,

Mr. Sclater-Booth said: I should like to ask one question, namely, whether the deputation comes here moved exclusively by the circumstances of the last two years. Because I am informed that only four of these excessive floods have occurred during a period of more than half a century, and it is quite certain that the Thames Conservancy Act was in Parliament with a view to amendment within a very few years.

It was replied that they had been more influenced by the late floods.

Mr Cross asked how much the Thames Conservancy had spent in the last few years in dredging the Thames?

Some one replied—£3,000 in the upper part of the river.

Mr. Sclater-Booth: No one will deny that the Thames Conservancy Board have very little funds for that purpose.

Mr. Cross, in reply, said: Well, gentlemen, you will not expect me to express any opinion to you on the very wide question you have opened to-day in regard to floods and scarcity of water; but, as you see, the President of the Local Board has heard all you have had to say, and you may rest quite assured that, after consulting with him, and after hearing the entire matter, I will bring the whole case before the Government, and see what course, in our judgment, ought to be taken.

A deputation from the authorities and riparian owners in the Thames Valley was also received in the morning by the Thames Conservators. The deputation was headed by Mr. Octavius Coope, M.P. The views of the deputation having been laid before the board, Sir Frederick Nicholson, who presided, said in reply that he regretted that they had not seen a report which was then before Parliament, and dealt with all the points that had been mentioned. If power were given them by Parliament, the Conservators were quite ready to levy rates and carry out all necessary work.

"THE TIMES," *February 27th*, 1877.

COLONEL RICHARDSON GARDNER, M.P., said he had the honour to introduce a numerous and influential deputation on the subject of the inundations of the Thames Valley, which had recently been so disastrous. The deputation was composed of a large number of riparian landowners, representatives of the Oxford University and town, Corporation of Windsor, and of all the other towns on the river banks, no less than twenty-three members of Parliament representing the boroughs and counties adjoining. It was estimated by those well acquainted with the subject that there had been a loss of property in the upper valley of the Thames of from £300,000 to £400,000, occasioned by the floods of the last few years; and there was no question but that means should be taken for the remedy of these recurring evils. There was another point of importance—that such floods polluted the river itself. An Act had been passed to oblige all towns to divert their sewage from the Thames; but all the agriculturists along the banks used manures of various kinds, which, being spread over the land, must necessarily be carried by the floods into the river, thus producing great injury when the floods occurred, and polluting the water which was drank by the inhabitants of the Metropolis, whose supply was largely drawn from the Thames.

The Very Rev. Dr. Liddell, Dean of Christ Church, said that Oxford, *mutatis mutandis*, was required to divert its sewage from the river. The town had borrowing powers to the extent of £100,000 for this purpose, but, looking at the gigantic works required, he was afraid that sum would be quite inadequate, especially if to the other troubles were to be added the floods. Oxford, therefore, was greatly concerned in all the facilities offered for draining the Thames Valley, for during the last eighteen months Oxford had passed several months almost as an island, and, considering the character of Oxford as the seat of the University, and of all appertaining to it, the condition of things in regard to places of this character became a question of national importance, and means, it was felt, ought to be taken to prevent Oxford from being subjected to this position. Nearly thirty years ago a committee was formed under the late Mr. Pusey, consisting of the agricultural landowners of the surrounding districts, for the purpose of finding the cause of the floods and a remedy. Various suggestions were made, but Mr. Pusey died, and now the agricultural landowners of the neighbourhood had framed a measure, under the auspices of an association of which Colonel Harcourt was chairman.

Sir George Bowyer expressed his belief that the drainage of the Thames Valley was a much simpler matter than was generally supposed. He believed that taking away weirs and other obstructions, and in some places cutting the circuitous bends of the river so as to make straight cuts, would be all that was necessary to put the river in a proper condition, and these things might be done at a moderate expense. The object should be to increase the sectional area and to increase the outfall. He referred to the Thames Conservancy plan, produced some years ago, and of that he spoke favourably, as a practical one, but this, he said, was opposed and was abandoned. He repeated that the resources of the Government should be employed in ascertaining what should be done, and in improving the outfall of the Thames.

Sir C. Russell, M.P., said that it was perfectly well known that it was impossible to do anything effectual unless they began at the outfall of the river and worked upwards. (Hear, hear.) Remedies for floods in the upper valley would only pour down an enormously increased stream of water with greater rapidity and regularity than heretofore, and, therefore, would increase the evils considerably below the parts of the Thames which had to be dealt with. While he strongly urged Her Majesty's Government to meet the evil by an investigation, those affected were perfectly willing to take a fair and reasonable share in the expense. But they did want some large comprehensive scheme for the whole river, and that could not be obtained except by Government assistance.

The Home Secretary asked—Can any one tell me how much the Thames Conservancy has spent in the last few years in dredging the Thames?

Colonel Harcourt replied—£3,000 in the upper part of the river.

Mr. Sclater-Booth remarked—No one will deny that the Thames Conservancy have very little funds for that purpose.

After a few other remarks,

The Home Secretary, in reply, said—Well, gentlemen, you will not expect me to express any opinion to you on the very wide questions you have opened to-day in regard to floods and other matters; but, as you see, the President of the Local Government Board has heard all you have to say, and you may rest quite assured that after consulting with him, and after hearing the entire matter, I will bring the whole case before my colleagues, and see what course, in our judgment, ought to be taken.

To the Editor of the "Times."—Sir,—As an owner of agricultural property in the valley of the Thames, allow me to say that I cannot agree with the deputation that waited upon the Home Secretary with respect to the Thames floods. I for one should strongly object to the floods being done away with altogether, as there can be no doubt that our grass meadows would not be nearly so productive as they are at present. It is true that we have suffered from those of 1875-76, but not so much as appears at first sight, as the amount of damage is only the difference between that caused by the floods and that caused to other land by the excessive rainfall. It must also be remembered that we have not had such floods since 1852, and may not have them again for another twenty years or more. The damage done by an occasional excessive flood would amount to very much less than the rates we should probably be called upon to pay towards any so-called improvements.

Your obedient servant,
GILBERT A. CLAYTON EAST

4, Hereford Gardens, Park Lane, February 26.

"The Times," *February 28th*, 1877.

Inundations.—Yesterday an influential deputation, including several Members of Parliament and Mayors, had an interview with Mr. Cross and Mr. Sclater Booth, at the Home Office, for the purpose of asking the Government to issue a Royal Commission for inquiry into the causes of the late disastrous floods throughout the Kingdom, the conditions of the great rivers and their tributaries, the powers possessed by the Conservators of such rivers, and the adoption of means for the alleviation of the present mischief.

Mr. A. Peel, M.P., introduced the deputation, and said that the present complaint had reference to nearly all the river basins in England. In the month of January, in Somersetshire alone, about 100,000 acres were under water from the overflow of the local rivers. That was the case also with a vast number of other places. The inundations were due to silting up, increasing subsoils, obstructions by mill-dams, weirs, and other artificial obstructions. Especially was there a neglect of the river banks and the bends of rivers. He referred to the neglect of rivers by Navigation Trustees, and mentioned particularly the river Ouse, which had been left without any jurisdiction over it. In some parts of the country large engineering works were required to enable the water of tributary rivers to escape, and the question arose who was to bear the expense, what was to be the area, and what the system of taxation. He had looked into the statutes on the subject from the time of Henry VIII. to 1861, and he thought that the Land Drainage Acts ought to be consolidated into one, they being at present in the greatest state of confusion. As to the area of management, what should be done? Were they to take the whole watershed or only a sectional part? It was urged that where there was a common outlet there they might have one jurisdiction; that separate interests might be under separate jurisdictions, with one general jurisdiction to regulate the whole. With regard to the system of taxation to be adopted, he did not think the rating clauses in the Act of 1861 worth anything for the practical purpose of the suggested improvements, there being no power under that Act to tax houses for improvements carried up close to towns which might be thereby benefited. Houses ought to contribute towards such improvements. The Irish Act had been pointed out as a model which certainly contained valuable principles that might be followed in regard to the area of taxation. The number of Improvement Acts throughout the country was about 1,000, and there should be a means of reconciling those private Acts with the general interests concerned, because in respect to the Navigation Trusts they impeded the use of the rivers and the main drainage of the country, besides clashing with other corporate bodies' right of control over such rivers. He was told that there was in the Home Office archives a Bill, drawn up by the late Sir George Cornewall Lewis, dealing very ably with the whole of this subject; if so, and that measure could serve present purposes, it would be most desirable. In conclusion, he said some specific management of rivers was absolutely necessary; the evil was growing year by year; the banks and beds were suffered to go to ruin; there was no one to look after the riparian owners; there was no community of interests sufficient to bind them together in any concerted plan; and if Mr. Cross thought a Committee of the House sufficient to inquire into the subject the deputation would be willing to be guided by his judgment.

Mr. Whitbread, M.P., urged strongly on the attention of the Government, as a practical measure to be at once taken, the question of the area to be taxed for any improvement in the rivers. Many remarked that those who dwelt upon the high land obtained great natural advantages over those below in the drainage of their land, which aggravated the evils of the floods in the valleys, and ought, therefore, to be made to contribute in a lighter degree than those in the submerged district. A man who drained his land was only exercising an immemorial right, and doing what Parliament had encouraged him to do by advancing him the means out of the public purse. But he thought that Parliament would be unwilling to adopt the principle of taxing the land *per se* for improving the channel of a river. The principle was very novel, and the cost on the land directly benefited by such improvements would be ruinous. He suggested as a means of ascertaining areas exactly that the Ordnance Survey now being carried on throughout the country should take in the rivers and basins not touched by the Survey, which would be of inestimable benefit in considering this question.

Several other gentlemen having addressed the Home Secretary,

Mr. Cross, in reply, said that no apology was necessary from them for the length of their statement, because the subject to him was a most interesting one. He was quite aware that what had happened during the last two years had drawn more particular attention to the state of the rivers throughout the country. He had, at any rate, shown that the Government had some interest in the question, because they sent Sir John Hawkshaw down to inspect the Clyde and to see what could be done. The result of that had been to show what had been fairly pointed out then —the great difficulty as to the question of taxation, which had in Scotland been the cause of great trouble. That matter was in abeyance, though he still thought that the report of Sir John Hawkshaw would be of great use, not merely as to the Clyde, but other rivers also. He was by no means disinclined to think that an inquiry of some kind or other was necessary, and he believed it was essential that they should have some information in order to deal with the question of rivers generally. His right hon. friend (Mr. Sclater-Booth) inserted clauses in the Rivers Pollution Bill a little while ago relating to this matter; but he thought that he wisely withdrew them for further consideration, and he now agreed with him that it should be authoritatively inquired into, though the means of inquiry, he thought, should be reserved for further consideration; but they might rest assured it would be not simply for the purpose of getting information, but for the purpose of legislation.

"STANDARD," *February 28th*, 1877.

THE numerical and representative strength of the Deputation which waited upon Mr. Cross at the Home Office, and upon the Conservators of the Thames at Tower Hill, may be taken as some measure of the amount of the mischief and inconvenience occasioned by the Thames floods in the district about London.

It was stated on Monday that the loss of property in the upper valley of the Thames in consequence of the floods during the last few years has been between £300,000 and £400,000, and that much of this has occurred within the last two years. Dean Liddell complains that Oxford existed as an island during a great part of the last eighteen months. Mr. Shaw-Lefevre likewise showed that the sewage works at Reading had all been disorganised by the overflowing waters. It is, indeed, a disagreeable reflection that these wholesale floods upset all attempts to divert the sewage from the Thames, seeing that the Thames goes to the sewage, and carries all away towards London, ready to be appropriated by the intakes of the water companies.

The Thames Conservators admit the occurrence of the floods, but state that only four of any great magnitude have taken place during the last fifty-six years. The Conservators institute a comparison between these several floods, in the course of which they make it tolerably clear that during the last flood, occurring early in the present year, the height of the waters at Sunbury, Moulsey, and Teddington was considerably reduced as compared with the flood of 1821, a result which we are told was "chiefly due to the effects of dredging, and likewise to improvements of the weirs near these latter locks." This at once suggests whether the same measures elsewhere would not be of service. * * * When the Teddington weir was broken down the other day, there was an immediate relief to the inundated lands above. The Conservators say that in carrying out all new works the escape of flood waters has been facilitated "where practicable." But they further state that the alteration of the road bridges, "which are so obstructive to the flow of the water," the deepening of the river, the lowering of the weirs, and the construction of enlarged tumbling bays, would also "assist the escape of flood waters," only, unfortunately, these operations "involve an expenditure beyond the means, and an interference with private rights beyond the legal powers of the Conservators." * * * The hopelessness of forming impounding reservoirs to arrest the Thames floods is pointed out. To catch one inch of the rainfall would require half a dozen reservoirs costing a quarter of a million sterling each. Nevertheless, it appears that the case is not altogether desperate, for the report states that a scheme was prepared in 1869 by which a large portion of the Thames Valley, including Oxford and its neighbourhood, would have been virtually raised nearly three feet, and so preserved from being flooded. But the riparian land owners objected to the rating clauses of the bill by which the scheme was to be carried out, and consequently the periodical inundations were allowed to continue. If so much could be done without any exorbitant outlay, it is a pity that it should remain undone. It appears there is a body in existence called the Thames Valley Drainage Commissioners, constituted six years ago, and having considerable rating powers. But it is evident that plans are useless without money to carry them out, and the riparian landowners must submit to rating clauses of some kind or other, if the waters of the Thames are to be kept below the level of the adjacent fields.

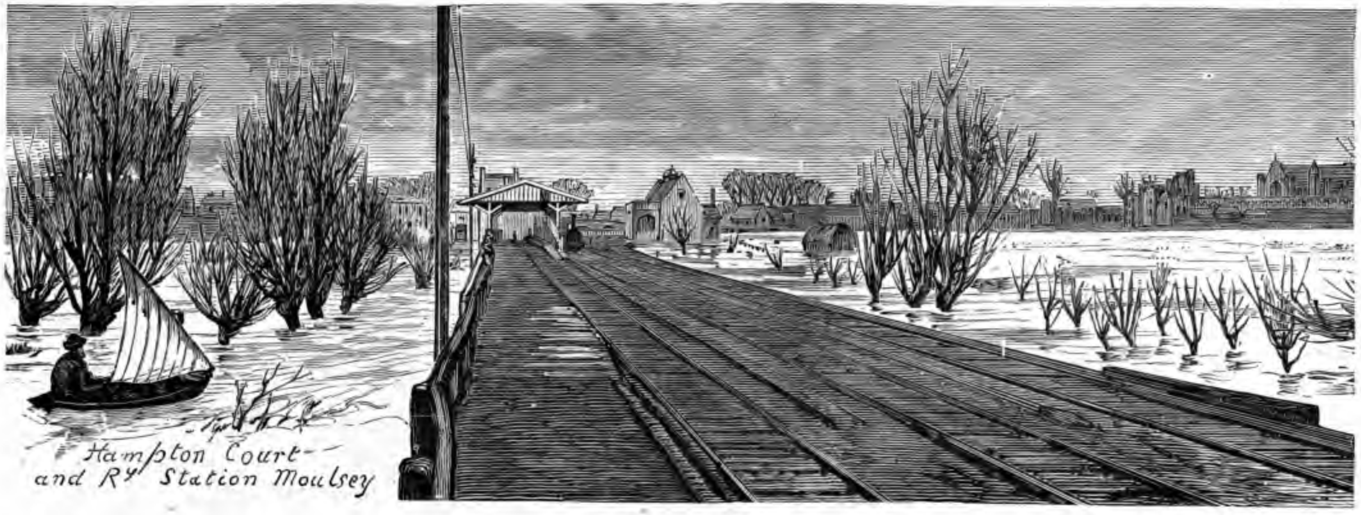
"PALL MALL GAZETTE," *February 28th*, 1877.

A MAN is clearly wise in speaking only of what he knows, and this may be an ample justification for the letter in which Sir Gilbert East discusses Thames floods exclusively from the standpoint of his own water meadows. There are other interests, however, to be considered besides those of riparian landowners, and a Thames flood reaches a good deal of land which is not permanent pasture. The human injury sustained from the floods has also a claim to be considered; and though there may be more grass in the summer following upon a flood, there may also be more disease. Perhaps a compromise might be arrived at by converting Sir Gilbert East's meadows into reservoirs for impounding the flood water, which could then be turned back into the stream when the river had sunk to near its usual level. By this expedient Sir Gilbert East would have his land properly irrigated, while his neighbours would be able to keep theirs dry; and, as both would get what they want, the cost of the improvement might fairly be divided between them.

"THE TIMES," *March 2nd*, 1877.

THE THAMES FLOODS.—Yesterday an influential deputation representing the conference of Metropolitan Vestries and District Boards who are unitedly opposing the Thames River (Prevention of Floods) Bill, had an interview with Mr. Cross at the Home Office for the purpose of submitting their reason why the Bill should not be read a second time.

Sir Charles Dilke, M.P., in introducing the Deputation, remarked that last year the Metropolitan Board of Works proposed to introduce a Bill to make the river-sideparishes pay the cost of embanking the River Thames Fulham parish, which was very poor, it was discovered would be ruined if compelled to embank its large extent of riverside, and attended the Metropolitan Board of Works to protest against the adoption of such a proposal, and that Board did not then introduce the Bill. This year, however, they had again brought forward the Bill, of course against which the Deputation protested to the utmost. The floods at Fulham had swept over market gardens and done a deal of damage to the parish, which was not thickly



Hampton Court — and Ry Station Moulsey

populated. They had strong objections to the general nature of the provisions of the Bill. The parishes at Hammersmith, Fulham, and at the end of the Metropolis would be almost ruined by the passing of that measure in its present form. There were those who thought that the embankments already made at the expense of the whole Metropolis had considerably added to the devastation of the floods. As a steam-launch owner and a rowing man, he could testify that those embankments had increased the floods.

The Home Secretary observed that there was little doubt of that.

Sir Charles Dilke added that, that being so, if it were necessary to embank the Thames all along the river-shore, the whole Metropolis ought to contribute its share of the expense. The present Bill the parishes could not accept, and it was advisable, if the subject was to be dealt with at all, that a new Bill entirely should be drawn up. Colonel Hogg proposed to refer the Bill to a Committee of the House for evidence to be taken on the subject, and power was given to those who felt aggrieved by it to appear by counsel and oppose it; but the clause conferring that privilege was so obscure as to make it doubtful whether persons so prejudiced by the Bill could sustain their right to be represented by counsel. Moreover, if they did so appear, it would entail more expense upon Local Boards than ratepayers would like to sanction.

Mr. Fowler, of the Metropolitan Board of Works, and as representing Lambeth, said that his parish were anxious that means should be adopted for preventing the flood from occurring so often; they, nevertheless, desired that any expense caused by the erection of fresh embankment should be shared by the whole Metropolis, especially as the Thames was the great water highway of London. The works to be carried out were too large for individual parishes to undertake at their own cost. He hoped Government would assist in so moulding the Bill that the wish of the deputation would be fulfilled.

Mr. Purdy, of Wandsworth, remarked that his parish had a foreshore of eight or nine miles to the Thames, and the population were the poorest of the poor. The present Bill was most unjust and inequitable.

Mr. Cozens, of St. Saviour's parish, thought it ought to be a Metropolitan charge, and not cast exclusively on the riparian owners.

Dr. Cortis, of Newington parish; Mr. ASTON, for Westminster; Colonel Beresford, M.P., as a riparian owner, and others spoke against the Bill in its present shape; and

The Home Secretary, in reply, said he would see the Chairman of the Metropolitan Board of Works and consult with his colleagues as to the best course to be pursued. Any course which could be suggested that would prevent delay would be an advantage. (Hear, hear.) He would ask Sir Charles Dilke whether he thought for a moment, if this Bill were read a second time and the Committee appointed, an instruction should not be moved for on going into Committee which would give the Committee power so to alter the Bill as to make the charge under it a general Metropolitan charge. He only threw it out as a suggestion.

Sir Charles Dilke did not think Sir James Hogg would consent, but thought he would rather drop this Bill than adopt that course.

The Home Secretary said that, anyhow, he would talk the matter over with Sir James Hogg, and in the meantime, if they would just be kind enough to think over that suggestion, he would see what could be done.

"SATURDAY REVIEW," *March 3rd*, 1877.

THAMES FLOODS.—The Thames Conservators have made a special report on the recent floods in the valley of the Thames. They have succeeded in showing that the Conservancy is not to blame for the loss and inconvenience which the inhabitants of this large district have had to put up with twice in the course of two years. But in showing this they have also shown that the constitution and powers of the Thames Conservancy are quite inadequate to the prevention of these evils. It cannot do more than it does unless it is armed with very much greater authority, and it certainly will not be armed with greater authority unless it is made to represent a very much larger number of interests than now find a place in it. * * * The Conservators have done a good deal in this direction, as every one who knows the river will admit, and nothing but the want of funds has prevented them from doing more. They have been blamed for spending all their available money on the district between Oxford and Staines, and neglecting the district between Oxford and Lechlade. Their answer to this complaint is that, though the navigation below Oxford is very much less than they would like it to be, still there is navigation; whereas above Oxford there is none, or next to none. When the Board has a little money to spend it is only reasonable that it should spend it on locks through which barges and boats do occasionally pass, rather than on locks at which it is not even thought necessary to station a lock-keeper. As regards the condition of the river above Oxford, about which so much has been said in connection with the recent floods, the Conservators seem to have done as much as they were competent to do. Their engineers prepared an improvement scheme embracing the whole course of the river between King's Weir and Sandford. This was ready as far back as 1869, and, if it had been carried out, it would have had the effect of raising the whole surface of the land subject to inundation in that district from two feet and a-half to three feet. The Conservators, though not in general favourable to comprehensive schemes, were impressed with the advantages which this plan offered to Oxford and the land in the neighbourhood. * * * When the Bill came before Parliament, the Conservators found that they had other people to reckon with besides the inhabitants of Oxford. The riparian landowners strenuously and successfully opposed the rating clauses, and, when the rating clauses were gone, the Bill ceased to be of any value. "Consequently the low-lying lands above and near Oxford are still subject to periodical inundations." Since that time the Conservators have pretty much left the floods alone.

* * * *

The argument against taking any extensive precautions against floods rests partly on their alleged infrequency, and partly on the cost of preventing them. In the last fifty-six years, it is said, only four great floods have occurred in the Thames Valley. Is the damage caused by these unusual and seldom recurring disasters great enough to make it advisable for the riparian landowners and occupiers, upon whom the cost must necessarily fall, to incur a very large outlay to protect themselves against it? * * * The Conservators hope, therefore, that "no amount of temporary inconvenience or damage will induce the Legislature hastily to authorise the construction of impounding reservoirs, or the carrying out of other schemes on a large scale which are certain to be extremely costly, and may not prove effectual remedies. * * * If excessive floods are to be dealt with, a searching preliminary inquiry should be instituted; for it is manifest that large powers and ample funds, only to be obtained by an Act of Parliament, must be provided if all the low-lying lands in the Thames Valley are to be secured against every possible inundation." It would be interesting to know why the Conservators looked at the matter so differently in 1870. They had not then had the experience of 1875 and 1877; in fact, there had been no great flood since 1852. Yet the Conservators thought the protection of the land above Oxford important enough to make it the subject of a careful investigation, followed by proposals involving the provision of large powers and ample funds by Act of Parliament. If this scheme seemed so important in 1870, eighteen years after the date of the then most recent great flood, why in 1877 is it passed over as only worthy of historical mention, when two great floods have occurred in the interval?

We entirely agree with the Conservators that, if excessive floods are to be dealt with, a searching preliminary inquiry should be instituted. It appears to us, however, that this inquiry should take a somewhat different direction than any contemplated by the Conservators. The reasoning of this report, though perfectly natural in a body in which the river and landowning interests are almost exclusively represented, is very inadequate to the necessity of the case. The Conservators argue as though the question under consideration turned wholly on a calculation to be made by the riparian landowners whether, on the balance, they lose as much by the floods as they would have to pay for the works required to prevent or lessen them. When large towns and numerous villages lie along the course of a river, the decision whether a flood or the works by which a flood is prevented are the more costly is not the only one to be considered. The injuries done to towns like Oxford and Reading and Windsor cannot be estimated by any return from the riparian landowners. Such a return takes no notice of the suffering inflicted on a very poor class of persons; of the heavy burden which the rate levied to relieve this suffering inflicts on a class a little, and only a little, better off; of the epidemics or general ill-health, scarcely less fatal, at all events from an economic point of view, than epidemics, which constantly follow upon floods. Man, at all events in the Thames Valley, is not an aquatic animal, and he cannot be left to live the life of an aquatic animal for some weeks in the year without being greatly the worse for it. If it is objected that it is unfair to tax the riparian landowners for the benefit of the townspeople of Oxford or Reading, the answer is, that nothing of the sort has been proposed. The objection to the report of the Thames Conservators is not that it seeks to protect the interests of the riparian landowners, but that it fails to recognise that there are any other interests to be considered. The first thing that has to be done, if excessive floods are to be dealt with, is to institute a searching preliminary inquiry into the constitution and powers of the Thames Conservancy. Hitherto it has been treated as little more than a navigation authority. Before it can take any effectual measures for the prevention of floods it must become, so to speak, a sanitary and poor-law authority as well. The interests affected by the Thames floods are far more various than the Conservators seem to imagine. But this fact, while it makes the prevention of floods in the Thames Valley more important, makes the cost to each separate interest very much less. There is no necessity that the burden should fall exclusively on the riparian landowners and occupiers, as the Conservators take for granted it must. On the contrary, every town and village along the course of the river ought to bear its share. Each suffers by the floods, each ought to be charged with its proportion of the outlay necessary to prevent floods. The first step towards an arrangement of this kind is to make the Thames Conservancy a really representative body, in which every Town Council and every Board of Guardians having jurisdiction in the district liable to floods should have its fair value. When the necessary outlay came to be spread over this large contributory area, it would cease to be so appalling as it may well seem when it is regarded as imposed upon a single class.

"IRON," *March 3rd*, 1877.

THAMES INUNDATIONS.

THE deluge with which this country has recently been afflicted has produced the usual fruit of all unusual phenomena—deputations to the Home Secretary and the President of the Local Government Board. * * * The destruction of property in the valley of the Thames is estimated very variously, Colonel Richardson Gardner assessing the losses of the "last few years" in the upper valley of the Thames at something between three and four hundred thousand pounds. From the composition of the deputation which waited upon Mr. Cross on Monday last, it may be that the riparian landowners—or at least a large number of them—are anxious that a proper inquiry should be made into the present condition of the river, with a view to the prevention of disasters in the future. There are, however, two sides to this as to other questions, and the challenge of Mr. Gilbert Clayton East—a landowner who rather likes a moderate amount of flooding than otherwise—coupled with the report of the Conservators of the Thames, throws some doubt on the necessity for interfering with the course of nature—so far, at least, as the upper part of the river is concerned. Three or four hundred thousand pounds is a heavy loss to spread over a few years, but the report states distinctly that only four floods of the magnitude of that of the present winter have occurred in fifty-six years, and the question therefore arises, "Are these floods sufficiently frequent, and is the damage caused by them so great as to make it advisable for the riparian landowners and occupiers, on whom the charge must necessarily fall, to incur a very large outlay with a view to prevent the extension or to mitigate the effects of such floods?" This should, it seems to us, be a question for the riparian holders themselves. * * * On this point Sir George Bowyer was unusually outspoken and unusually amusing. The idea that landowners whose property adjoins the Thames should become objects of peculiar solicitude to the country, because that silent highway, "the most important historical river in the kingdom, passes by two great seats of learning—Oxford and Eton—and passes the chief royal residence in the country, besides running through the Metropolis," is one of the happiest inspirations of an eccentric legislator. The neat little touch about the "chief royal residence"—which, by the way, is rarely used—is charming in its simplicity. * * * The impounding reservoir scheme has the effect of being both costly and inelastic. * * * Another plan is to remove the so-called "obstructions" in the form of weirs, and let the water run off freely to the sea. All existing rights being set at naught, this would be an effectual plan in seasons of flood, but what shall be said of those of drought? We have not forgotten the outcry about the low state of the river during recent summers, and the bitter complaint that the scour occasioned by the Thames Embankment had reduced the bed of the river at Richmond to the condition of a gravel pit. * * *

It is worth while to contrast the attitude of the riparian owners up the river with that preserved by the wharfingers on the Surrey side of the metropolis. The Thames Embankment remains a lop-sided affair, simply because the Metropolitan Board of Works cannot grapple with the gigantic question of compensation. It was met, as far down as Blackfriars on the northern shore, but the occupiers of the southern side, like the landowners higher up stream, cannot be dealt with on terms within the power of the Board. It seems strange that the Conservancy cannot enforce the maintenance of proper barriers. In Lambeth and the low-lying district on the south side of the metropolis, it is not a question of a few miles of meadow being overflowed, but of thousands of people being washed out of their houses, and of goods of great aggregate value being destroyed. The worst feature of all is the ridiculously partial character of the Embankments opposed to the river, thrust over from the northern shore. Fragmentary barriers may be almost said to increase the mischief, for the water, penned in for a while, soon finds a passage, and sweeping round, attacks in flank the position impregnable in front. It is unquestionable that the dwellers on the south side of London have suffered from the Embankment on the north, and, in common fairness, should have an Embankment of their own. The financial difficulties are, we hear, insurmountable, at least for the present; but we have not heard that the Lambeth householders, like the landowners on the upper course of the Thames, have yet asked for Imperial assistance, on the ground that Lollards' Tower is invested with peculiar "historic" interest.

"WEEKLY DISPATCH," *March 4th*, 1877.

THE Thames Conservancy issued a report in which there is a very fair account of work done in the way of repairs and improvements, in spite of great want of funds applicable to the upper district above Staines, and it discourages any great expenditure in reservoirs or other extensive works executed with the object of guarding against any possible inundations. The opinion of those experienced in the care of our unruly river is very valuable, and there is certainly much to be said against sinking a large amount of capital in order to prevent the chance of future loss. The case, however, is one, not of loss of property only, but, in our towns, of danger to life and health and other great personal inconvenience, and as negligence in any part of the river renders it impossible to guard the thickly-populated districts from inundation, the whole must be regarded as of equal importance. The questions, then, are, who can be trusted to do the work, and who are to pay for having it done? Sir James Hogg's bill proposes to entrust the matter to the Metropolitan Board of Works, or to such vestries, local boards, or persons as the board shall require to act. The expenses would then be local, each district having to pay the expenses of the works along its own portion of the banks. * * * * * If a lock is rebuilt so that the landowners on each side of the river near the spot can increase their rentals, they may well afford to hand over the unearned increment to lighten the burden of the expense, and when Sir George Bowyer talks of the wrongs of these proprietors he forgets that it is their land which will be directly benefited by the proposed improvements. The case requires Government interference, in order to ensure a uniform and thorough execution of the works all along the banks of the river.

"THE TIMES," *March 5th,* 1877.

THE debate of Friday on the Declaration of Paris prevented the Thames Floods Bill from coming on for its Second Reading; but there are few Bills outside the class of political measures which deserve or will receive more careful attention. The two Deputations which waited upon the HOME SECRETARY last week bear witness to the great interest felt in the subject and to its wide bearings. There seems a very natural apprehension abroad lest the exceptional sufferings of particular districts during the winter should occasion partial legislation on the subject, and a very reasonable anxiety is displayed to impress upon the Government the fact that general and national interests are involved in it. A river is, in fact, of all natural objects, the one which affects the most numerous and most diverse interests. It is an artery which feeds, fertilizes, and connects districts the most dissimilar in their character and the most conflicting in their ordinary occupations. To name, for instance, the various properties and industries affected by the Thames from Oxford to Gravesend would be to enumerate a long series of agricultural, manufacturing, and private interests such as would be no unfair representation of a great part of English life. Seats of learning like Oxford and Eton, manufacturing towns like Reading, the innumerable parks and seats which adorn the banks of the river, the rich pastoral meadows, and the agricultural villages, are all linked together in one common interest by the stream which flows past them. It is impossible materially to affect the river at one point without affecting it everywhere. We have already been obliged to recognize the intimate connection of all towns on the river's banks in respect to drainage, and until recent measures were passed on that subject the inhabitants of the metropolis were condemned to drink the diluted sewage of all the towns in the upper course of the Thames. We are now reminded that the residents along the whole course of the river are more or less bound up together in respect to its overflow. In proportion as the drainage of the lands along the upper part of the river is rendered more complete and easy, in the same proportion are floods rendered more probable in the districts lower down. On the other hand, precautions taken against such floods near the mouth of the river may have the effect of damming up the water in the upper reaches, and, consequently, inflicting upon the inhabitants the floods which are escaped below. An embankment, even, on one side of the river, may do an injury to the other side by throwing the water over towards it. In short, almost everything we do in one place may inflict some counterbalancing injury upon another place. A river is faithful to the primary law of fluids, that it transmits pressure equally in all directions simultaneously.

It is, perhaps, not a matter for surprise that in such circumstances there should be signs of a kind of fatalist disposition to acquiesce in things as they are and make the best of them. More than one speaker at the deputations, and even the President of the Local Government Board himself, adopted a tone which would seem more natural in a native of India discussing the periodical famines in that country. The idea on which we are acting in India, that a famine is a thing which ought to be averted or remedied, is a purely English importation. The native notion is that it is a thing to be submitted to—just as the inundations which not long ago swept away a vast population at the mouth of the Ganges will have not the slightest effect in discouraging the settlement of others in the desolated districts. Natives are no more disturbed by such incidents than we are by the daily and hourly fact of death. Droughts, famines, and pestilences are in their view part of the order of nature, and must be submitted to. They are not, perhaps, without their consolations to those who escape, and they have, at least, the advantage that they diminish the number of mouths to be fed. It is our task in India to rouse the natives, if possible, from this helpless fatalism, and if we cannot prevent famines, at least to be prepared to avert their natural consequences. But we should be unwise for this purpose to send the President of the Local Government Board or some of the Conservators of the Thames to Madras and Bombay. Mr. Sclater-Booth the other day enquired of a deputation whether they were moved exclusively by the circumstances of the last two years. He asked the question, he said, because he was informed that only four of these excessive floods had occurred during a period of more than half a century. He may not have intended it, but his question will be taken to imply that it might, perhaps, be best to put up with a disaster which thus only recurs at tolerably long intervals. Similarly, the Conservators of the Thames are aghast at the expense which they apprehend may be necessary to insure complete protection from such misfortunes, and question whether it is advisable to incur a very large outlay with a view to prevent the extension or to mitigate the effect of such floods. A more helpless frame of mind could hardly be conceived. We do not suppose it is generally prompted by the charming simplicity of motive betrayed by Sir Gilbert East in the letter he addressed to us the other day. "I, for one," he said, "should strongly object to the floods being done away with altogether, as there can be no doubt that our grass meadows would not be nearly so productive as they are at present." Sir Gilbert East contemplates the interests of the country at large from the point of view of his grass meadows, and appears quite unconscious that villagers, townspeople, and, in short, all persons who have not grass meadows, are taxed very heavily when a flood ensues to provide him with a good substitute for manure. The helplessness on which we comment probably arises simply from the extreme complexity and difficulty of the subject; but it is unworthy of the Local Government Board, or of the inhabitants of the Thames Valley themselves, to accept periodical devastation in this way as a sort of inevitable fate. It may be well doubted, indeed, as was suggested in answer to Mr. Sclater-Booth, whether floods are likely to be so comparatively rare in the future as they have been in the past. There can be no question that the extent to which we have carried the system of under-drainage tends to flood the river far more rapidly than hitherto, while, on the other hand, the property damaged by floods has increased enormously. It was estimated by the spokesman of one of the deputations last week that the loss of property in the Upper Valley of the Thames in consequence of the floods of the last few years amounts to no less than three or four hundred thousand pounds. Any such estimate is more likely to be under than above the truth, while nothing can measure the injury and, it may be, the disease inflicted upon the towns on the banks of the river. Oxford, said the Dean of Christ Church, has of late been in the condition of an island, and it is easy to understand what mischief such a condition must cause. It is equal childishness and injustice to sit with our hands before us in the presence of such disasters, and it has become imperative to adopt some precautions on the subject.

There is, of course, no need to enter upon any such extravagant works as the Thames Conservators seem to dread. No one wishes to embank the Thames from its mouth to its source. But there is a great interval between such extravagance and the absolute neglect which at present prevails. Until a very recent time, it will be remembered, the whole navigation of the Thames was in risk of become impeded for want of due attention. Locks were falling into ruin, and the bed of the river was silting up. This neglect is now being remedied, but that it should have waited so long for a remedy is an illustration of the general apathy which had prevailed in respect to the management of the river. If floods cannot entirely be prevented, very much might be done to check and to control them. Inconvenient bends in the river might be removed and weirs attended to. There is good reason, in short, for the suggestion which was pressed upon the Home Secretary by both the deputations of last week—that he should institute some systematic inquiry into the subject. It might be by a Royal Commission or by a Committee of the House of Commons, or, in the first instance, it might be simply an engineering report by some such competent authority as Sir John Hawkshaw. Until we know what could be done, and its probable expense, we are in no position to deal with the question in detail. The Bill introduced by the Metropolitan Board of Works may have an important reference to the parts of river above the Metropolis, and it is necessary that a comprehensive view should be taken of the question. A Committee or a Commission would present the advantage of being able to consider the proper incidence of charge, but an inquiry of some kind is the first requisite, and it is an urgent one.

THE "STANDARD," *9th March*, 1877.

THE question asked by Mr. A. Peel in the House of Commons last evening, and answered by the Home Secretary when replying to Mr. Coope, as to whether the Government were about to make inquiries into the management of rivers and drainage areas, was obviously intended as a sequel to the interview which took place a few days ago between Mr. Cross and a deputation of landed proprietors and local authorities introduced by the member for Warwick. To that deputation Mr. Cross replied that the state of the rivers and the drainage connected with them was a subject in which he took great interest, and he was by no means disinclined to think that an inquiry of some kind or other was necessary, especially with a view to deal with the question of rivers generally. In reply to Mr. Peel's interrogation last evening, Mr. Cross could go no further than he had already gone in responding to the deputation. It was obviously reasonable to wait for the further discussion of the subject, which is to be brought on by a motion already placed on the Order Book of the House of Commons. The due management of rivers is rapidly assuming an importance similar to that which once attached to the sanitary government of towns. The Public Health Act has provided a system of sanitary administration for the whole of England, including the largest towns and the smallest hamlets. This being accomplished—a matter which once seemed almost to defy arrangement—there now springs up another element. The question is not as to towns and hamlets, but rivers and streams. As a matter of fact, the towns and the rivers are closely associated, and the circumstance that the towns polluted the rivers has created a good deal of our sanitary legislation, culminating at last in the Rivers Pollution Act. But rivers have their influence on the country as well as on the towns, and there is a phase of this river question which is half sanitary and half agricultural. The extraordinary inundations which have lately affected several of our river basins may be attributed to excessive rains. On the other hand, the mischief of the rain has probably been aggravated by the neglected condition of our rivers. It is generally considered that a town ought to possess a certain unity in its government. Even in the case of so vast a population as that of the metropolis, it is often urged that there ought to be one great governing body, instead of the duality which now prevails. At all events, it is well understood that two sewer authorities in one town would be an absurdity, and, indeed, there exists one great drainage Board for all London. But our rivers, excepting the Thames and the Lea, with, perhaps, one or two more, are divided into as many sections as there are local authorities along the banks, if indeed the local authorities care to have anything at all to do with the rivers except to spoil them.

During the time of the Royal Sanitary Commission Lord Robert Montagu was very emphatic on the importance of creating water-shed boards, so that the rivers might be dealt with on a comprehensive principle. There was much force in his lordship's arguments, and although the Public Health Act has overcome some of the difficulties respecting areas which at first appeared insuperable, the case of the rivers may possibly have to be dealt with somewhat after the fashion proposed by Lord Robert. The exclusion of solid refuse from the streams by the provisions of the Rivers Pollution Act is a great point gained. But the extension of agricultural drainage is producing an effect on the rivers somewhat analogous to that which was brought about by the drainage of the towns. The rivers, indeed, are not grossly polluted by land drainage; but they are made to overflow at one time, and run short in their volume at another. It has been stated that since the Thames Valley has been better drained the floods in the Thames reach their maximum at Abingdon Bridge in thirty-six hours, whereas a flood used to take seventy-two hours to attain its greatest height. We shall, perhaps, be told that the Thames affords an example of a river already under one general management, seeing that there is a Thames Conservancy Board. Yet there is a ready reply to this in the statement made by the Conservators themselves, that the funds at their disposal are altogether inadequate for the due control of the upper navigation. We cite the case of the Thames as illustrating on a large scale what is the process now going on in respect to most of our rivers. The Tweed has been quoted as showing that a river may be so managed, even in a well-drained area, as not to overflow, or at least not to pour forth any disastrous floods. As we have before intimated, the question of rating is a matter of perplexity in relation to the management of rivers. But the subject is one which will ripen by degrees, and Mr. Cross is evidently disposed to take action directly the necessity shows itself and the proper course becomes apparent.

"DAILY TELEGRAPH," *March 14th.*

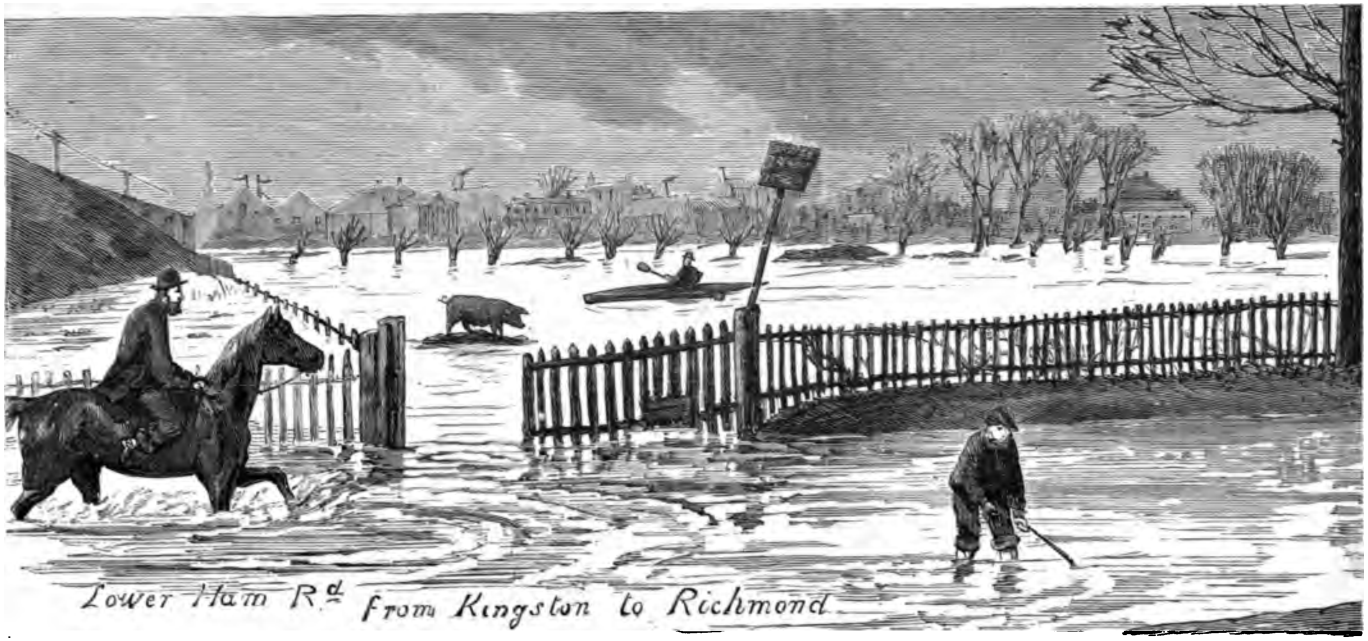
HOUSE OF COMMONS, *Tuesday, March 13th,* 1877.

NOTICES OF MOTIONS.—Mr. Coope: On April 10 to move for a Select Committee to inquire into the injury inflicted by floods in the Thames Valley, with a view to prevent their recurrence.

"THE TIMES," *16th March,* 1877.

THE FLOODS THROUGHOUT THE COUNTRY.—Mr. Arthur Peel asked the Home Secretary whether any decision had been come to in reference to instituting an inquiry into the causes of floods throughout the country, and whether in the opinion of the Government, a Royal Commission would not be the most suitable mode of ascertaining facts and suggesting remedies.

Mr. Cross replied that Her Majesty's Government had had the subject of the floods throughout the country under consideration, and they thought it was a subject about which inquiry was certainly necessary. The time of this House was at present fully occupied, both in Committees and otherwise, and therefore they had



Lower Ham R^d^ From Kingston to Richmond

come to the conclusion that the better course would be that the inquiry should be undertaken by a Committee of the House of Lords in the first instance, the Government reserving to themselves the right, when the Committee had reported, to appoint a Royal Commission afterwards, if necessary, to inquire into specific points in the inquiry, but not to take the shape of a roving Commission.

"THE BUILDER," *17th March*, 1877.

IMPROVEMENT OF THE THAMES.—Of all the thoroughfares in London, the most important is that of our tidal river, which bears the traffic of the universe to our swollen population; and yet there is no other metropolitan causeway which has not a large amount of rates expended annually in paving, sweeping, cleansing, with other outlays for the convenience of passengers, and the accommodation of trade.

What the river requires is a well-regulated system of dredging, to remove the slime which defiles the exposed beds at low water; to *deepen the channel*, so as to allow a larger outflow of water throughout its whole width, but more especially on the east side of London Bridge, where at certain times of tide there is a fall and strong current, which impede ordinary navigation; for years, since the foundation of the bridge, its massive piers would seem to have occasioned an obstruction and accumulation of silt and waste, and notwithstanding the erection of quay walls between Blackfriars and Fulham, on the north, and between Westminster Bridge and Lambeth Palace, on the south side, which ought in some degree strengthen the current, still the shallows, filth, and squalor seem to increase.

* * * * *

So extensive and varied are the works required to complete the objects here referred to, that private enterprise, or the good intentions of several great riparian owners can accomplish little; it is to the Board of Works alone that the public can look for an effective embankment. The admirable completion of the embankment, and, indeed, the useful and efficient improvements carried out and now in progress, under supervision of the Board, have excited not only the admiration, but the gratitude of the whole community; therefore to that Board is deferred the consideration of the question,—what can be done to rectify the deformities, expurgate the squalor, and increase the commercial advantages of our noble tidal river?

T. H. H.

"THE TIMES," *March 21st*, 1877.

DRAINAGE.—The Duke of Richmond and Gordon gave notice that on Friday next he would move for a Select Committee to inquire into the operation of existing statutes in regard to the formation of and proceedings by Commissioners of Sewers, Drainage, and River Navigation Boards; to consider by what means such bodies may be more conveniently and inexpensively constituted, their procedure improved, and their powers enlarged, so as to provide more efficiently for storage of water, the prevention of floods, and the discharge of other functions appertaining to Conservancy Boards.

"DAILY TELEGRAPH," *March 21st*, 1877.

FLOODS.—Mr. Cross informed Mr. Ryder that the Committee on the Prevention of Floods would be requested to consider the storage of water also.

"THE TIMES," *March 21st*, 1877.

DRAINAGE AND NAVIGATION.—The Duke of Richmond and Gordon, on rising to move for a Select Committee on the subject of drainage and navigation, said that after the recent prevalence of floods their lordships would not be surprised that Her Majesty's Government had taken up this question. The first proposal for dealing with the subject originated in a motion made in the other House of Parliament by an independent member, but the terms of that motion were much more limited than that which he would have the honour of submitting to their lordships. Her Majesty's Government thought it desirable that the terms of the proposal should be extended and enlarged, because while a measure for preventing the pollution of rivers passed last year, several clauses of that Bill as it was originally presented were struck out, it being thought better that the matters to which they related should be dealt with in a future Session. The Government proposed, therefore, that those matters should come within the reference to the Committee for which he was about to move. The constitution of Commissioners of Sewers and of Conservancy and Irrigation Boards was regulated by various Acts, going as far back as the reign of Henry VIII., but the first attempt made to grapple with the subject in any large manner was by an Act passed in the 24th and 25th years of the reign of Her Majesty the Queen. The floods which had occurred in several parts of this country, and more especially in the valley of the Thames, seemed to have reappeared at various intervals—in 1821, 1852, 1875, and 1877 for instance,—and their recurrence showed that while the powers vested in Commissioners of Sewers and in Conservancy Boards might be useful, and perhaps sufficient, for ordinary purposes, they certainly were not adequate to the prevention of extraordinary occurrences. (Hear, hear.) The Conservators of the Thames pointed out as much. In their report presented to the Board of Trade, February 16, 1877, the Conservators of the River Thames stated that "in all ordinary floods the improvements made at various places and the stringent regulations as to opening the tackle at the weirs . . . . leave no just ground for complaint." But they added, "The capacity of the river being insufficient to carry off excessive floods caused by an enormous quantity of rain falling in a comparatively short time, the water must necessarily spread over the low-lying riparian districts." After dwelling on the long intervals at which extraordinary floods occurred, with the exception of the present and last year, and the great expense which would be entailed by the construction of "impounding reservoirs" or any like scheme, they went on to say:—

"If excessive floods are to be dealt with, a searching preliminary inquiry should be instituted, for it is manifest that large powers and ample funds only to be obtained by an Act of Parliament must be provided if all the low-lying lands in the Thames Valley are to be secured against every possible inundation."

It seemed natural that at the same time as the prevention of floods was under consideration, attention should be called to the storage of water for drinking purposes. Much valuable evidence upon this subject would be found in the report of the Pollution of Rivers Commission, which was made in 1874. In the final conclusions and recommendations of that Commission, it was stated that—

"The supply of villages and hamlets with wholesome water is often a problem of great difficulty, since the number of inhabitants is too small to permit of the execution of expensive works for such an object. We therefore recommend that in any scheme for the utilisation for town supply of the pure water of a river basin, the wants of all neighbouring villages and hamlets should be provided for as far as practicable; and we further recommend that the owners of land should be permitted to include the cost of village water supply among those expenditures on land improvements which they are now enabled with the sanction of your Majesty's Enclosure Commissioners to charge upon their estates."

There was another subject which required attention—namely, the functions of the Navigation Boards now in existence. Those Boards had been incorporated from time to time, but in consequence of the construction of railways, navigations on the canals and rivers in charge of those Boards had, in many cases, lost their *raison d'être.* In reference to the Wye and another river, there were no fewer than four Acts of Parliament. He thought their lordships would agree with the Government that all the matters which he had briefly indicated were well worthy of reference to the Select Committee. The noble duke concluded by moving for a Select Committee "to inquire into the operation of existing statutes in regard to the formation of and proceedings by Commissioners of Sewers, Drainage and River Navigation Boards, to consider by what means such bodies may be more conveniently and inexpensively constituted, their procedure improved, and their powers enlarged, so as to provide more efficiently for storage of water, the prevention of floods, and the discharge of other functions appertaining to Conservancy Boards."

The Marquis of Ripon said that no doubt one cause of the greater prevalence of floods in recent times was the improvement in surface drainage, which caused so much more water to rapidly reach the rivers. Again, it was incontestable that navigation and drainage were, to a certain extent, opposed to each other, and it might be highly desirable to give greater facilities for the abandonment of navigation in cases where, owing to railways, the latter had become useless, or where it seriously interfered with drainage. He entirely approved the proposition of appointing the Select Committee, and would strongly impress on his noble friend the Lord President, to have the Committee nominated without delay, in order that it might be able to report in time to have legislation for the prevention of floods before the close of the present Session. (Hear, hear.)

Earl Fortesque joined in the request made by the noble Marquis that no time might be lost in nominating the Committee in order that it might commence its labours as soon as possible.

The motion was then agreed to.

THE country has had such terrible experience of the season's floods, and its remembrance of them is still so lively, that the Duke of Richmond's proposal for a Select Committee on Drainage and Navigation Boards will be very welcome, and will be thought to have been made none too soon. The case is one in which the chief work of a Committee may be both easily and efficiently discharged. The facts are patent, and have in some part been already made the subject of inquiry. The remedy will be more difficult. As we gather, however, from the speech with which the Duke of Richmond introduces the question, and especially from his concluding words, the duty of the Committee will not extend to devising means for checking or moderating what seems just now to bid fair to become an annual infliction. This will be the business in detail of the separate Boards which are to be charged, as now, with the care of rivers large and important and mischievous enough to be thought worthy of such special tutelage. It will be for the Committee to determine what new powers are to be granted to these bodies, or what convenient changes can be introduced into their constitution or method of procedure. It is certain that there is room here for improvement. In addition to such complaints as have been urged against the Thames Conservators as not representing the interests of the bulk of the riparian proprietors, in addition to such complications as the Duke of Richmond himself instances in the case of the Boards in charge of the Wye, we have the broad fact that the floods of last season and the season before, and of several other seasons earlier in the century, have proved more than a match for the ordinary resisting forces of the River guardians. We must either be prepared, therefore, to submit from time to time to a recurrence of these annoyances as often as the season may be a little more wet than usual, or we must insure our immunity by some new precautions beside and above those which we have tried and have found wanting. That the thing to be done is beyond our strength is what Englishmen will not very readily suffer themselves to be persuaded. The defect, they will with more reason conclude, must be either in the will or the power of the bodies to which the unperformed duty has been confided. It is to these points accordingly that the Duke of Richmond's Committee will especially address itself. It will show how far the River Boards of the country are fairly representative of the interests of which they have the care, and how they can be made representative where they are not so already. It will also ascertain the power with which their members are already vested, and in what way these can be strengthened where they are found at present defective. When the Report has been presented there will remain only the easy duty of giving legislative effect to its recommendations, and the new Boards, or old Boards with renovated forces, will be at once able to set themselves to the task for which they will then presumably be prepared.

There is, as Lord Ripon observes, somewhat of an antagonism between two principal objects to which our River guardians have to attend. The effectual drainage of a district will often imply the carrying off of water which for purposes of navigation is by no means excessive; while to keep rivers at a depth sufficient for navigation, and to maintain a reserve force which will secure that depth to be lasting, must often involve measures which will lay under water a good many square miles of the adjacent country. This, of course, is so far in the nature of things that we cannot hope it will be altogether remedied. In many instances a choice will have to be made between the two objects, and the one or the other will be sacrificed. The difficulty, however, will frequently be less in practice than at first sight it may appear. The case of each river must be judged on principles of its own. Inundations, it may be borne in mind, are not always thought prejudicial by the riparian owners. Low lying pastures suffer much less than cultivated lands from even the prolonged presence of water on their surface. Their holders, as our readers were reminded a few days ago, will be found protesting against the changes which are thought necessary for their neighbours' safety. There will seldom be any objection on their part to the river of their district being kept full enough to afford a highway for navigation, and the certainty that, if so, it will sometimes be too full will be regarded by them as by no means objectionable. It has, in fact, come to be thought the normal state of things with some of our rivers that they should periodically overflow their banks, and the prospect of this has determined the use to which the surrounding lands have been put. It must be in this sense, we presume, that we are to understand the statement of the Thames Conservancy Board that in ordinary times there is nothing in the state of the river to furnish fair grounds for complaint. The country bordering on the upper reaches of the Thames is, we know, covered regularly with water for some weeks, and occasionally for some months, in the course of each year, and we believe further that this might be prevented with no great difficulty. We must suppose the Board, therefore, to acquiesce in a state of things to which the holders of the flooded meadows have no objection, and of which the navigation company have certainly no reason to complain. We may remind them, however, in this exceedingly typical instance that the two contented classes do not quite exhaust the list of those who ought to have a voice in the matter. Besides barge owners and water meadow owners there are the inhabitants of the towns and villages around which the waters are permitted to spread themselves. The interest of these is clearly adverse to that of the others, and their numbers are very much more considerable. At one point of the river's course comes Oxford, and a good deal lower down Eton. It is a little hard that undergraduates and schoolboys, and the hosts that collect around them, should suffer as they do by the consequences of Thames overflows. In ordinary seasons it is bad enough, but in seasons like that through which we have just passed—we ought, perhaps, to say like that in which we are at present—the nuisance becomes well-nigh intolerable. Thus much, indeed, the Board very freely admits. We could wish they had made a more full confession of their shortcomings. Between allowing the river to fall short of water and keeping it at its full present standard there is surely a middle course possible that will give the one side as much as they can fairly ask without at the same time inflicting needless damage upon others. But even if we accept the Board's view of the way in which their duties are, as a rule, discharged, there remains still the recurring case for which they do not pretend to have made, or to have attempted to make, any proper provision. We must be prepared to deal with the Thames and with many of our other rivers in exceptional as well as in common floods, and the consequences of neglecting this are apt to become exceedingly serious, as recent experience only too clearly shows. Here, then, is ample cause for the appointment of a Select Committee such as the Duke of Richmond proposes. Their instructions will, fortunately, be wide enough to cover the entire case which we would wish to see referred them. When our Boards of River Conservators have been strengthened and regenerated, and made more fairly representative of rival and conflicting interests, we shall expect to find that they do not entirely endorse on any point the somewhat easy optimism of their predecessors.

The important question of water storage is, it will be seen, among those which the Duke of Richmond's Committee is to investigate. It seems certainly absurd that we should devote all our efforts at one time of the year to getting rid of an element which, as we are well aware, we shall want before the year is ended. It would seem wiser to retain it, or, at all events, some of it, until the occasion for it has once more come round, There are plenty of places in which the supply would be most welcome. There is often, as the Report of the Pollution of Rivers Commission tells us, great practical difficulty in providing villages and hamlets with wholesome water. The inhabitants are not numerous enough to cover the expense of great engineering works, and they are consequently too apt to be left dependent upon their scanty and uncertain and even bad local resources. The cure, however, is by no means so simple as at first sight it may appear. The superfluous waters are on the low grounds. The suffering, or prospectively suffering, villages are on the heights. A local reservoir constructed where the floods are most abundant would be of little service for places which the floods never approach. The subject thus falls in, as, indeed, the Commission's treatment of it seems to imply, with the general question of the provision of good water for town use rather than with that of the prevention of floods. The way in which it must be dealt with is, as the Report urges, by linking town and country together in one common scheme, and by treating a good water supply as one of those matters of prime necessity which the present holders of land may be permitted to charge permanently upon their estates. We trust there will be no delay in proceeding with what is from more than one point of view an important national affair. Lord Ripon is, perhaps, a little too sanguine in his belief that we may be prepared by next winter against a repetition of the present winter's floods. To take precautions of this kind, or, rather, to enter upon preliminary inquiries with a view to enabling others to take precautions, will be but a part of the entire business of the Committee. However good an use we may make of the intervening months, the distance between the Committee's appointment and the actual settlement of the very wide questions with which the Committee is asked to deal is scarcely to be passed over quite so rapidly. There are a good many steps to be taken, and the possibility, therefore, of a good many mishaps or slips. Our less ambitious hope must be that so-called exceptional weather will not be found to recur for three years successively. A little respite, if we can have it, ought to be enough for us. We have had our warning, and we shall deserve to suffer again if, some seasons hence, we are again caught unprepared.

"SATURDAY REVIEW," *March 31st*, 1877.

THE SELECT COMMITTEE ON FLOODS.

IT is an ill wind that blows good to nobody, and the floods of the past winter have at all events brought with them a Select Committee. Hopes are even held out that, if the Select Committee does not find out all that can usefully be known on the subject, it may be followed by a Royal Commission. On the whole, there is no reason to be discontented with the form which the inquiry is to take in the first instance. Select Committees like to present their reports by the end of the session in which they have been appointed; whereas Royal Commissions occasionally seem to forget the flight of time. A well-chosen Lords'Committee is an excellent instrument for getting at facts; and it will be able to command the testimony of as many experts as it may find necessary to examine. What is less satisfactory is the slight reference made in the Duke of Richmond's motion—there was rather more about it in his speech—to the question of village water supply. The impression which a subject makes on the public attention bears no relation to its real importance. The suffering caused by a flood is probably not half so great as the suffering caused by the droughts which seem to be a regular part of an English summer, or by the want of wholesome drinking water, which in many districts is felt all the year round. But, to all appearance, if there had been no floods, there would have been no Select Committee. When an inquiry is to be made into the best means of preventing floods, it is impossible not to give the storage of water a place in it; and as the storage of water is only one among many means of supplying villages with something to drink that is not sewage, there is a chance that the Committee may be drawn on until, by the time that their labours are ended, the enquiry has become very much more comprehensive than the terms of the instruction promise. We should have preferred to see the coequal importance, to say the least, of the question of village water supply formally recognised in the order of appointment. It is better, no doubt, that it should come in incidentally than not at all; but, so long as it has no recognised place in the inquiry, there is always a danger that the Committee may be disinclined to enlarge the scope of their proceedings, and may reject a great deal of evidence which, though it would have been strictly pertinent to the larger investigation, can only come on sufferance into the restricted one. The best thing to do at present, therefore, is to consider on what plea the Committee may be induced to examine witnesses whose information relates to village water supply as well as those whose information is limited to floods.

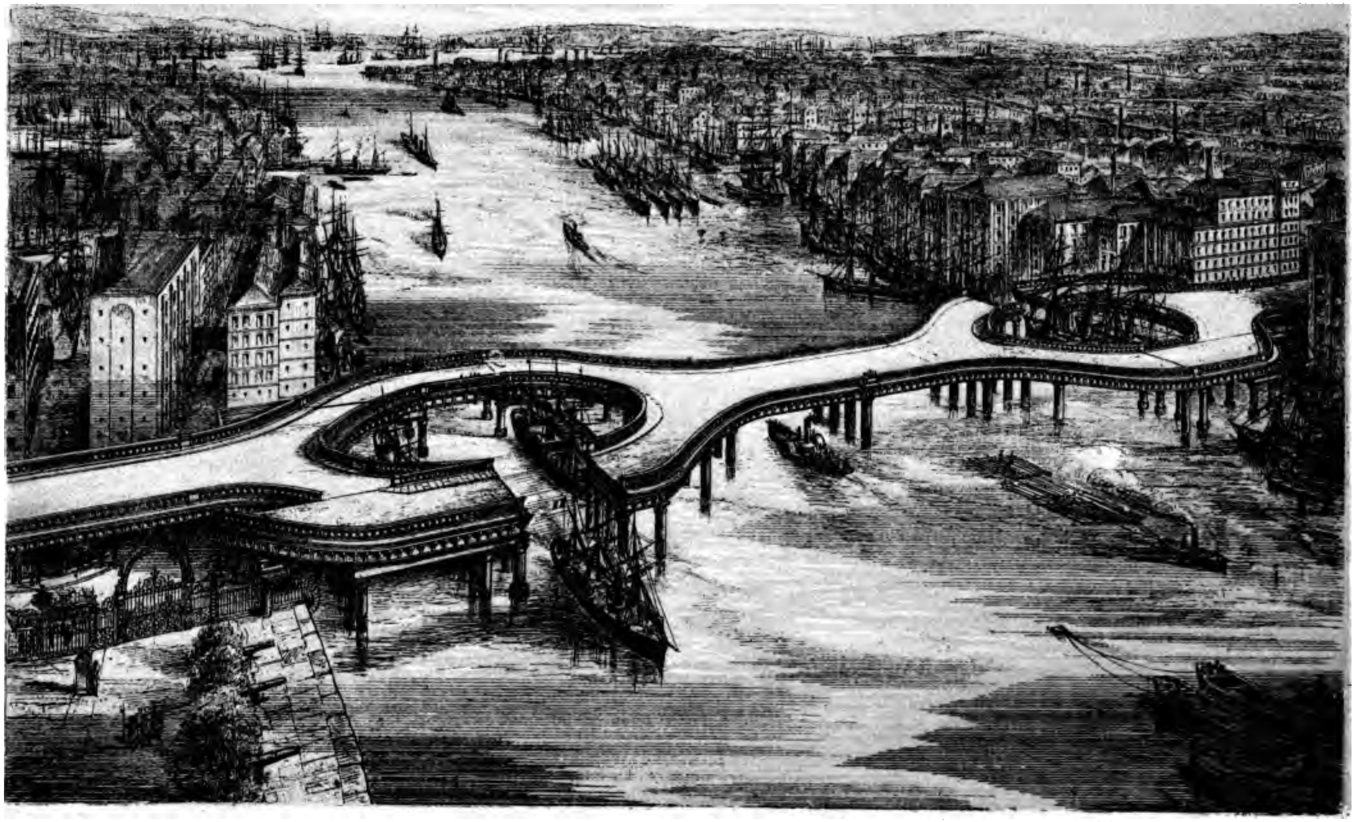
If the order of defining the matters with which the Committee are to deal had made no mention of the authorities into whose constitution and functions they are to inquire, this would be an easier business. As the words stand, however, village water supply seems at first sight to be altogether excluded. The only authorities mentioned are Commissioners of Sewers and Drainage and Navigation Boards, and it cannot be denied that the natural meaning of these terms points to an inquiry limited to the means of disposing of the superabundant water with which rivers are burdened in time of flood. For example, in the Thames Valley the Thames Conservancy will answer to this description; but what has the Thames Conservancy to do with the water supply of villages lying at a distance of many miles from the river-bank? It exists to see that the channel of the Thames is kept free from obstruction, and that the locks and weirs which make navigation possible are in a state of decent repair. Clearly no inquiry into the present constitution of the Conservancy Board can be of much use as regards matters so distinct as a supply of water for domestic use and a supply of water for the purpose of carriage. Nor, supposing that the Committee placed a very liberal construction on their instructions, would it be expedient to treat the Thames Conservancy as a body to be invested with large additional powers in this way. To lay upon them the duty of supplying the Valley of the Thames with water would be to assign them a duty to the discharge of which they would be in no way suited. The supply of water cannot be separated from the supply and regulation of other sanitary needs. The authorities that have the management of the one must have the management of the other. If therefore the Select Committee are to extend their inquiries to the question of water supply, they must go beyond the authorities mentioned in the Duke of Richmond's motion. Whether they shall do so will naturally be decided by their estimate of the importance of the subject, and from this point of view it may be useful to recall the disclosures of the last few years with regard to the drinking water of villages. No doubt, if this were suddenly made all that it ought to be, some new causes of ill health would disclose themselves; but it is scarcely too much to say that epidemic diseases as we know them would almost disappear. Whenever there is a more than ordinarily conspicuous outbreak of fever in a village, the Local Government Board sends down a Medical Inspector to investigate the causes of it. The results of these inquiries are annually published by the Department, and in almost every case it proves to be the water supply that is in fault. "Sewage pollution" is the phrase that occurs with sickening regularity in these documents. The villagers have gone on drawing their drinking water from sources which may have been pure when the village was a fourth of its present size, but which have long since ceased to be pure. It is the only water within their reach, so they have no choice but to drink it; but so long as they do this they are exposed to a certain outbreak of typhoid or cholera if a single example of either disease finds its way into the village, and to the deterioration of health which probably results from a long course of sewage-poisoning even when sewage is not impregnated with any specific epidemic poison. The reports of the Officers of Health to the various rural authorities amply confirm the reports of the special Medical Inspectors. The more the subject is looked into the worse the facts appear to be.

We submit that this is a state of things which will fully justify the Lords' Committee in giving a very free interpretation to their instructions. It would have been better, of course, if the Government had included the water supply of villages among the objects of the inquiry; but, as they have not done this, the next best thing is for the Committee to make the addition for themselves. They can manage this, if they are so minded, under cover of the words " storage of water." This is expressly named as one of the points which they are to investigate, and the storage of water will be mainly useful as a contribution towards the solution of the problem of water supply. It is true that impounding reservoirs are among the means that have been suggested for regulating the discharge of the flood water through the rivers. But if this were the only reason for making reservoirs, it is very doubtful whether they would ever be made. The expense of storing water in this particular way is very great, and unless the reservoirs were built on an enormous scale they would scarcely exercise an appreciable effect upon a flood. Storage of water, in the natural sense of the words, means storage for the use of a village; and if once this is conceded, it will be idle to examine the merits of competing schemes without considering what other sources of water supply are available. It may turn out that to divert the sewage from the neighbouring watercourses or to dig new wells at a greater distance from the cesspools would provide a sufficiently pure source from which water may be drawn. If, therefore, the Select Committee inquire into the storage of water, their labour may be entirely wasted if they do not inquire at the same time into the means by which the storage may be rendered unnecessary. The Duke of Richmond, in moving the appointment of the Committee, implied that the provision of water for villages was somehow to be included in the investigations of the Committee; but he seemed to regard storage as the only machinery the merits of which it was necessary to consider. It happens that among the districts that have most conspicuously flooded during the past winter is the country between Brent Knoll and the Bristol Channel, and nowhere are the villages worse supplied with drinking water. But if the Committee were to recommend the storage of water in order to save these villages from drought, they would be ignoring the existence of springs on Brent Knoll which would yield any quantity of pure water if there were only some authority to lay down pipes for its conveyance. Here is a sufficiently pertinent example of the mistake of making the scope of the inquiry too limited. Happily it is not too late for the Government to add words including the water supply of villages among the specific objects of the Committee's investigations, and this would clearly be a better way out of the difficulty than the most ingenious device for bringing in the question by the head and shoulders.

THE RELIEF
OF
LONDON BRIDGE
AND ITS APPROACHES.

PALMER'S BRIDGE WITH SHORE BASINS.

Plate. 2.



C.F. Kell Lith 8, Castle S^t Holborn. E.C.

THE PROPOSED TOWER BRIDGE FROM SUMMIT OF TOWER.

THE RELIEF OF LONDON BRIDGE AND ITS APPROACHES.

IN treating of the subject the author does not propose to discuss the necessity for affording relief to the traffic passing over London Bridge—this being universally acknowledged—nor does he propose to examine in detail any of the schemes which have been brought forward for widening the present bridge, or otherwise increasing its capacity for traffic, as such schemes are now acknowledged to be of a mere temporary character, and incapable of affording a satisfactory solution of the question, which of late years has occupied so much of the attention of the public.

Before proceeding, however, to state what he considers to be the proper and most efficient method of providing adequate accommodation for the traffic, it will not be out of place to recapitulate briefly the leading points in the history of the existing bridge, and to examine some of the proposals which have been brought forward with a view to its relief.

Old London Bridge, which supplanted the original wooden structure, appears to have been completed about the year 1209, after occupying 33 years in building. Mr. Samuel Smiles, in his "Lives of the Engineers," remarks upon it as follows :—

" The bridge, when finished, was a remarkable and curious work. That " it possessed the elements of stability and strength was sufficiently proved " by the fact, that upon it the traffic of London was safely borne across the " river for more than 600 years.

" The piers of the bridge were so close, and the arches so low, that at " high water they resembled a long low series of culverts hardly deserving " the name of arches. The piers were of various dimensions, in some cases " almost as thick as the spaces of the arches which they supported were " wide. The structure might be compared to a very strong stone embankment built across the river, perforated by a number of small openings, " through which the water rushed with tremendous force as the tide was " rising or falling, the power thus produced being at a later period economised and employed in some of the arches to work water-engines.

" The bridge had not less than twenty arches, including the drawbridge,

" some of them being too narrow to admit of the passage of boats of any " kind. This great obstruction of the stream, at a point where the river is " about the narrowest, had the effect of producing a series of cataracts at the " rise and fall of each tide, so that what was called 'the roar of the bridge' " was heard a long way off. The feat of 'shooting the bridge' was in those " days attended with considerable danger, and lives were frequently lost in " the attempt.

* * * * * *

" The drawbridge was another curious feature. It occupied the four- " teenth arch from the north end, and provided an opening of about thirty " feet. It was used for the purposes of defence, as well as to provide for the " passage of masted ships."

In 1746 one of the arches was widened, and some 25 years afterwards the historian Chamberlain writes:—

" The wretched disproportion of the arches, the great fall at low water, " by which many of His Majesty's subjects have been annually lost, is a " disgrace to the City, and we hope the time is advancing when a sense of " the dangers and inconveniences of this bridge will inspire those in whose " power it is to apply for the aid of Parliament, towards erecting a superb " and magnificent structure, which may do equal honour to the taste, " policy, and humanity of the present age."

Shortly after this date several proposals were made for the construction of a new bridge, and amongst these was one by Mr. George Dance, the City architect, who furnished a design for parallel bridges, 300 feet apart, provided with drawbridges for the passage of vessels. Other designs were also submitted to the Port of London Committee, including one by James Black, for three elliptical arches of granite, the centre one being 65 feet high, and estimated to cost £294,089; and one by Telford and Douglas, of a cast-iron bridge of a single arch, 65 feet high and 600 feet in the clear: its cost being £262,289.

The receipt of the drawings of this last bridge with the one span suggested to the Committee the desirability of inviting scientific men to furnish further plans.

In 1801, General Sir Samuel Bentham took this opportunity to present a design of a novel type, the chief feature being an enlargement in the centre, hexagonal or octagonal in shape, supplying in the middle a basin sufficiently spacious to contain one or more masted vessels.

Referring to this latter scheme Mr. Joseph Sill, in his pamphlet published in 1813, entitled *Observations concerning London Bridges*, writes as follows:—

" I give here a sketch of a plan proposed by General Bentham, with a " double drawbridge, constructed to admit ships to pass through it at all " times, without occasioning any interruption to the land communication " over it, which he estimates, in the year 1801, not to exceed £210,411.

" Thus, while the vessel is passing the first drawbridge the other is

" down, and when the second is pulled up the first is let down, so that no " interruption to carriages or foot passengers takes place.

" The vessels might be eased through by means of proper hawsers with " the greatest security and convenience."

In the year 1823 an Act for the " rebuilding of London Bridge, and " for improving and making suitable approches thereto," obtained the Royal assent, and the design of the late Mr. Rennie for the present bridge was adopted, and its construction commenced in 1824. It was completed and opened for public traffic in 1831 ; the cost being £506,000. From the rapid growth of the population of the Metropolis, not very many years elapsed before complaints were heard that the accommodation afforded by the new bridge was insufficient to meet the ever increasing wants of the traffic, and in 1852 the matter was brought before the Court of Common Council. In 1866 Mr. William Haywood, the able City Engineer, in a report on the traffic improvements in the public ways of the City of London, wrote as follows :—

* * * * * *

" It may be computed that there now pass into the City daily three-" quarters of a million of human beings, and that the same number passes " out at night, and this vast daily influx is equal to one quarter of the " whole metropolitan population.

" The total number of vehicles which passed over the following " bridges in twenty-four hours in June, 1863 :—

" London Bridge	25,960
" Southwark Bridge	1,094
" Blackfriars' Bridge	10,653

* * * * * *

" London Bridge, with its approaches, is the most important, and con-" stitutes a line which, next to the east and west line, is more inadequate " to the public wants than any thoroughfare in the Metropolis.

" London Bridge is the only roadway across the Thames for the popu-" lation of a great area stretching far away into Essex on the north side, " and Kent on the south side of the river.

* * * * * *

" East of a straight line drawn five miles to the north and five miles " to the south of London Bridge, are comprised districts containing in " 1861 a population of 667,000 on the north, and 282,000 on the south, or " a total of 949,000, and is now probably fully 1,000,000, or equal in " number to one-third of the metropolitan population, and to this must " be added districts to the west of the line, and others further to the north, " south, and east, for which London Bridge is the only highway over the " Thames.

" For the traffic of this great community, already equal to four of the

" largest towns in England, there is but one bridge on the river having a " width of carriage way of 35 feet, and a total width of 54 feet.

" There is but one complete remedy for this, which is the formation of " a new bridge or tunnel, with suitable approaches, lower down the river " than London Bridge.

" A bridge so situated, with approaches opening for a sufficient distance " to the north and south, would not only relieve London Bridge, but would " relieve effectually the whole line of street from the " Elephant and Castle " " to Shoreditch Church, as it would also ease Eastcheap, Fenchurch Street, " Leadenhall Street, and many other thoroughfares of the City.

* * * * * *

" For the relief of London Bridge, I propose that a new bridge should " be constructed farther down the river. The best situation for this is " either west of the Tower, by Great Tower Hill, or east of the Tower, " between that ancient structure and the St. Katherine's Docks.

" For the immediate purposes of the traffic, the west side is the best; " but looking to all circumstances, the east side is preferable.

* * * * * *

" There will be no difficulty in forming the bridge with good gradients. " The cost of this work would doubtless be very great, principally on account " of the compensation to the wharfingers.

" The wharf property would, however, not be valueless, even if vacated " by its present occupants.

* * * * * *

" And especially in the interests of the future population these improve- " ments should be carried out at once, for fifteen or twenty years hence " they will cost double what they now would cost, great as that outlay " might be.

* * * * * *

" That, looking to the future as well as to the present necessities, and " having regard to the fact that the cost of present improvements will pro- " bably be in a degree cast upon a future generation, they should be planned " and carried out on the broadest and most comprehensive scale, that no " obstacle should be allowed to interfere with this principle, and that such a " course is true economy."

* * * * * *

Mr. Haywood concluded by saying that " Billingsgate Market might be transferred to another site." That the shutting out of seagoing steamers from the river above St. Katherine's Docks would, looking to the facilities shortly to be afforded by the Metropolitan Railway, not be very inconvenient, although " quite aware that formidable trade interests would have to be " disturbed, and that a section of the public must thereby suffer some incon- " venience; but sooner or later such disturbance is inevitable, and after all " it resolves itself into a question of compensation and nothing more."

Excepting the views contained in the last paragraph, the author entirely concurs with Mr. Haywood, but regrets that he has not since that date —now more than ten years ago—thought fit to modify these latter opinions, when addressing the Press on the subject of London Bridge.

No practical steps were taken after Mr. Haywood's Report was made to carry out its suggestions, and matters continued to progress from bad to worse, until eighteen months ago, when the question was again taken up by the press and general public, in so decided a manner that the author believes it will not be allowed to rest until some practical solution of the difficulty is arrived at.

As a result of the discussions on the subject, various proposals have been brought forward —and these may be divided into two classes—those for giving relief to London Bridge by widening it, or otherwise increasing its capacity for traffic, and those for constructing bridges or road tunnels lower down the river. Of the former class, the only scheme brought prominently before the public was that of Mr. Horace Jones, the City Architect, and Mr. C. Hutton Gregory, the well-known Engineer. These gentlemen proposed to widen the present bridge by the addition of light iron arches to carry the footways, thus giving an additional width of 11 feet on either either side. From the first there was a strong feeling against the proposal, it being felt that it would disfigure one of the choicest architectural features of the City; and the more the scheme was discussed, the more evident it became that, if carried out, it would prove of mere temporary utility, and that sooner or later one more comprehensive must be adopted.

Finally the idea of tampering with the present structure was abandoned, and attention turned to the alternative method of dealing with the question, by means of bridges or tunnels lower down the river.

Of the schemes of this class proposed we may mention the following as the most important:—

1st. A tunnel, passing under the bed of the river.
2nd. An hydraulic lift bridge, an exact opposite to the latter, placed 90 feet above high water level.
3rd. Steam Ferries, one of which will be in operation in a few months.
4th. A rolling bridge.
5th. Two low level bridges alongside each other, one for road and the other for railway traffic.
6th and lastly. A double drawbridge on a low level.

1st. **THE TUNNEL PROJECT** comprises a carriage road about half a mile long, to be reached by spiral shafts 100 and 70 feet in depth respectively, on gradients of 1 in 40, carriages and pedestrians being obliged, in ascending, to turn 3½ times round the northern shaft, and nearly 3 times round the southern, to quit the gloom and stuffiness of the tunnel for the pure air and light of day.

This tunnel would be some 100 feet below the level of the roads of the approaches. The design can, seemingly, only be approved as in no way interfering with the important river traffic.

2nd. **THE HYDRAULIC LIFT BRIDGE** is to consist of three arches, each 90 feet above Trinity high water, to admit the passage underneath of lofty masted vessels.

This scheme has the advantage of being in the open air, but, as the traffic would have to be lifted and lowered vertically, it cannot be relied on.

3rd. **STEAM FERRIES.**—A Limited Liability Company has been formed for the construction of steam ferry-boats to ply between Wapping and Rotherhithe, and the determination to conduct this experiment does immense credit to the energy and enterprise of its promoters.

The principle of the ferry is as follows :—On each side of the river a pier is constructed with hydraulic lifts, raising and lowering a platform from which the passengers are embarked, to the level rendered necessary by the height of the tide.

It is proposed to run two steamers simultaneously, one from either shore, every fifteen minutes, each steamer having, approximately, a capacity for six loaded waggons and a small number of foot passengers.

The steamers in shape are nearly rectangular, with an outside measurement of 82 feet long by 42 feet beam. They are fitted with paddle-wheels, constructed to turn the boats in their own lengths, and are to receive and discharge their traffic lying end on against, and on a level with, the platform, which is raised and lowered as above described.

Although the distance from shore to shore is only some 800 feet, the actual distance travelled by the boats in the majority of instances will be some 1,800 feet, as owing to strong tides running at right angles to their course, the exigencies of fogs, and passing river traffic, they will be obliged to describe a curved track, not unlike the travel of the crab.

Taking 1,300 feet (the mean of the above distances) as the average space to be traversed, and four miles an hour as the rate of progression, nearly four minutes would be occupied in transit, leaving one minute for making the boat secure, and five minutes for the receipt of traffic at either side of the river.

At this rate of working these two steamers—the greatest number that could be used between these piers—and taking an average of 12 hours daylight throughout the year, 96 journeys per day would be made, and 576 waggons conveyed across the river, that is on the supposition that the boats carried their full complement at each journey.

The author has given these details, as he understands the Ferry Company have applied for a site higher up the Pool, between the Tower and St. Katherine's Docks. While acknowledging that by the adoption of an improved class of boats better results can be obtained than he has named, he is strongly of opinion that no ferry, however well conducted, can be placed in the same category with regard to utility as a bridge.

Lastly, the proposed tariff for this, and we presume similar ferries, is entirely antagonistic in principle to the Bill before Parliament for freeing toll-bridges. The rates are as follows:—

Vehicle with 1 horse	Empty	8d.	Loaded	1s. 6d.
,, 2 horses	,,	1s.	,,	2s. 6d.
,, 3 ,,	,,	1s. 3d.	,,	3s. 3d.
,, 4 ,,	,,	1s. 9d.	,,	3s. 9d.
Pedestrian				1d.
Cattle, per head				3d.
Saddle-horse and rider, or led horse and attendant				6d.
Barrow or Truck				2d.
Cab, 2 or 4 wheels				8d.
Carriage, 2 or 4 wheels				1s. 4d.
Every vehicle or machine propelled by means of steam or machinery, or by any other power than animal power, each wheel				2s. 6d.
Omnibus and servants, with one or two horses				1s.
,, ,, with four horses				1s. 6d.
Passengers, per head				1d.

4th. **A ROLLING BRIDGE.**—This is designed to convey the traffic across the river without interfering with the navigation. It consists of a platform 300 feet in length, travelling on piers 100 feet apart, having rollers on the top and carrying the machinery for working the platform. The idea is ingenious, but in the author's opinion impracticable, as—apart from the inconvenience which would necessarily arise—should any derangement of the machinery leave the platform with its load of vehicles and passengers stationary in the centre of the river—the constant passing and repassing of the platform would interfere with the navigation to much greater extent than would a drawbridge at a fixed spot. Any break down in this plan, the steam ferry or the hydraulic lift-bridge, such as might occasionally happen, would cause a block and a pressure of traffic that would of itself be fatal to their adoption.

5th. **TWO LOW-LEVEL BRIDGES ALONGSIDE EACH OTHER—ONE FOR ROAD AND THE OTHER FOR RAILWAY TRAFFIC.**—These two bridges possess what in the author's opinion is the great defect of shutting out from the Upper Pool the continental and other steamship traffic. Their construction would involve the payment of compensation to wharfingers and others of a sum of probably not less than £3,000,000 to £5,000,000 sterling, an outlay which, as the author will endeavour to show, is totally uncalled for and unnecessary.

Lastly. **THE DOUBLE DRAWBRIDGE.**—The Author has now to examine the proposal of Mr. Barnett to construct a Double Drawbridge. This proposition has excited so much public attention that a Company has been formed for the purpose of realizing it; and a Bill is now before Parliament to procure the necessary powers.

Mr. Barnett's scheme seems to be identical in its leading features with that proposed by General Sir Samuel Bentham in 1801, which was described as under :—

" Its principal characteristic was an enlargement in the centre into a " sex-angular form of more than twice its ordinary breadth, having in the " middle an octagonal basin, spacious enough for a ship to lie in without " touching a drawbridge constructed in each side, which drawbridges were to " be 30 feet wide, and so contrived that either should be sufficient for a temporary passage; and the vessel having passed through one, it was to be " let down and fixed before the other was opened." *(Plate 4.)*

The description of Mr. Barnett's bridge which follows is in his own words as extracted from the "Journal of the Society of Arts," giving an account of a meeting held at the Society's Rooms to consider the project.

"I now come to the fourth project, my own. A bridge that may be " built in any part of the Thames with easier gradients than any bridge " over the river, but allowing through any part a clear passage for barges, " steamers, and other craft, yet with the exceptional provision and capacity to " allow large ships with the highest masts to pass through up to London " Bridge, without stopping for one second the vehicular and passenger traffic. " My patent bridge, has but one approach from each shore. When these approaches have extended into the river about one-third its width, the roadway splits into two roads, each the same width as the approaches, by easy " inclined angles, outwardly extending till they meet midway, thus forming " a sort of angular oval or loop, in the largest diameter. I have on each " side two openings, practically covered and united by platforms, turning on " their centres, each opening or closing by one operation. These openings " permit the entrance on the port side of the largest ships that come up the " Thames; there is also a sufficient width allowed for the length of the ships " within the loop. From the central piers on which the turntables work, " there is extended a platform uniting the two extremes, so that this platform lies with the axis of the river, dividing the loop into halves, furnishing the means of mooring the ship a few minutes alongside by mooring " blocks. There are two other platforms running parallel to the chief platform, which keep the ships straight on their road. The vessels return on " the opposite, still going port; thus all risk of collision is avoided. The " platform will have narrow lighters, rising and falling with the tide, thus " protecting both piers and vessels from injury. As soon as a vessel is about " to enter the loop, the roadway on the side by which it is to enter is closed, " and the vehicular and general traffic, by closing the gates (when the roads " divide), is diverted to the opposite side; then immediately the turntable-" bridge is opened, and the vessel enters the loop, so that when it is fairly in, " the bridge is closed behind it, and, as before described, the traffic is " diverted on the road behind the ship, and the opposite turntable-bridge is " opened, suffering the ship to pass out on its way; by these means the " traffic will suffer neither delay nor inconvenience, the vehicles and general

" traffic will pass imperceptibly from one side of the loop to the other. " Neither frost nor fog will prevent the traffic across the river, which must " inevitably occur with the ferries.

" London Bridge, acknowleged by all nations as one of the noblest in " the world, need not be desecrated by extraneous additions, during his life " strenuously opposed by Sir John Rennie; but this noble monument should " be left unimpaired to fulfil its mission to ages yet unborn."

" This bridge can be built in any part of the river without interfering " with or injuring the immensely valuable property that covers its shores.

" It would avoid the loss of valuable time and the wear of horses and " vehicles travelling daily and unprofitably in the aggregate thousands of " miles to reach London Bridge, and often returning on the opposite shore " the same distance to reach their destination.

" It is certain that a low-level bridge must shortly be built below " bridge. It is also evident that an ordinary one must stop the passage of " big ships on their way to the wharves.

" This would ruin the wharves between it and London Bridge, in " which case I am assured the City or the Metropolitan Board of Works " would have to pay as compensation over three millions sterling. The " adoption of my patent bridge will obviate the necessity of giving one " farthing compensation.

" On the contrary, the land required for the approaches to the new " bridge at its present value could be bought at such a price as would " quadruple itself by the time the bridge was built.

" On the improved locality great warehouses and factories would " rapidly spring into existence, and yield such profits as would more than " likely recoup the whole temporary outlay.

* * * * * *

" Should my patent bridge be adopted, I should propose that it be " either a girder or trellis bridge, with three granite piers on each side, on " which the moveable roads should work.

" Either girder or trellis bridges possess great advantages; firstly, by " occupying so small a part of the stream by the columns that carry the " roadway; secondly, by their costing such an inferior outlay; and, lastly " by their rapidity of construction.

" I have little doubt such a bridge could be opened for traffic in less " than two years from its commencement.

* * * * * *

It is now time to inquire into the merits and disadvantages of Mr. Barnett's bridge.

It commends itself as a low-level bridge with easy gradients, provision being made for masted vessels to pass into the Upper Pool.

Its drawbacks are:

A. The very great danger, if not impossibility, from the position of the openings in the centre of the river of passing vessels through during strong tides, making it practically a time bridge.

B. The difficulty, with two openings having swing-bridges pivotted on the pier between them, of making use of more than one opening at a time.

C. The great and valuable mid-channel water space which it occupies.

The proposed construction deprives unmasted boats and vessels of the readiest means of passing up and down the river, and seriously interferes with the free passage of the tidal waters, causing thereby strong currents which render the passage of vessels through the openings, even under ordinary circumstances, a matter of risk.

D. There are no fewer than four sharp angles to turn in passing over the bridge, all close to one another.

As the bridge will be extensively used by heavily laden waggons and timber teams passing to and from the docks on either side, many from 50 to 70 feet in length, these sharp turns are serious drawbacks.

E. Should either of the swing-bridges, or the machinery for working them, become disabled, the upper wharfingers must suffer the greatest inconvenience and loss of money through their vessels being unable to pass on either side.

With reference to these drawbacks, attention is invited to Captain Townshend's remarks, extracted from the discussion on Mr. Barnett's Paper in the "Journal of the Society of Arts," dated March 15th, 1876:—

Captain Townshend, R.N., wished to put one or two questions from a seaman's point of view, with regard to the working of the proposed bridge. In the first place, had any estimate been made of the amount of traffic likely to pass through the bridge, which would, of course depend in a great measure on the position in which it was placed? If it were put below the docks, the traffic would be so great as to cause much difficulty he feared, but if it were near the Tower it would only affect vessels coming up to that part of the river, between there and London Bridge. Again, how long would it take a vessel to pass through what he might call the locks? If it were still water there would be no great difficulty in that, but seeing that the tide in the Thames ran about four knots an hour, and that in order to get steerage way, a vessel would require to go six knots with the tide, it would be rather awkward. Going against the tide it would be comparatively easy, but with the tide his impression was, that the only safe way would be to swing round and go through stern foremost, steaming against the tide, and so getting a fair steerage way through the water, but not really moving forward over the ground, or there would be a great danger of going smash against the second bridge. Then the time required to go through must be estimated, and the number of vessels requiring to pass, in order to see if there would be sufficient accommodation. He could not tell what effect the piers would have on the tidal flow, but if that were not important, there might be more than one bridge made, if necessary, to accommodate the traffic. It was a very ingenious plan; and if it were not open to any of the objections he had suggested, it would solve a problem, which often appeared a difficult one, where there was a great deal of traffic.

Captain Townshend's views respecting the difficulty of passing through such a bridge would be endorsed by every seaman experienced in the handling of vessels in tideways.

So far as the rate of current is concerned, four knots an hour is but an ordinary river tide. Six or seven knots are not unusual when the Thames is swollen with rain, as it has been recently. It cannot be presumed that vessels would choose this particular time with a full head of tide on for entering or leaving the Upper Pool, but it may and often does happen that steamers, particularly those trading with the Continent, running as they do with almost the regularity of mail boats, are obliged to arrive and depart without reference to exceptional states of the tide.

Vessels would, therefore, on arrival at a bridge such as Mr. Barnett proposes, with a central current rushing through his openings at an accelerated and dangerous speed, be obliged to wait for slacker water; the result being that, occasionally, a large number of vessels would have to be passed through the openings in a short space of time to the great interruption of the road traffic.

Looking at the working capabilities of Mr. Barnett's swingbridges so far as the time occupied to pass vessels through is concerned, it may be fairly assumed that the channels on either side of his central supports or piers must be each 50 feet wide, thus giving some 150 feet as the average length of the swingbridge; allowing this to be revolved at a speed of two miles an hour, 44½ seconds would be needed to open or shut the roadway and channels.

On referring to Mr. Barnett's drawing published by the Patent Office, and assuming that his channels are each 50 feet wide, a length of clearance room for vessels' masts of about 200 feet exists in either passage.

This length is more than ample, as vessels over 280 feet in length, with say a width between the fore and after masts of some 180 feet, seldom use the Upper Pool; but if the mast distance is reduced to 180 feet, such reduction would, still assuming passages 50 feet wide, a width absolutely necessary for workable ship openings, but slightly alter the dimensions and form, which must be nearly as follows:—

The width of the Thames at Irongate Stairs, the proposed site for the Tower Bridge, is 825 feet.

Only 125 feet of single bridge roadway can exist at each shore end, or 250 feet in all, if very excessive turns in the roadway are objected to. 575 feet of central river area would remain, and this width would be needed for Mr. Barnett's central loop carrying the two roadways, supposing the four angles of turn in the road are each 45 degrees or half a right-angle. If the angles are greater the loop would be practically unable to accommodate a stream of heavily teamed waggons, whilst if less or easier, the double roadways or loop would reach from shore to shore.

Returning to the question of time available during slack, generally high water, it appears from authentic sources that an average number of 144 ships come up the river into the Higher Pool during six consecutive days, which quantity, 24 vessels daily, not counting a large number of masted sailing vessels, has to be dealt with.

On Wednesday, February 28th, and Monday, March 5th last, the author spent a considerable time on the river between the site of Mr. Barnett's and his own proposed Tower Bridge and London Bridge; purposely selecting those dates to ascertain the minimum number of vessels, as Sundays and Wednesdays, the usual sailing days, would leave the Upper Pool very empty.

VESSELS IN THE UPPER POOL.

	Sailing day Wednesday, Feb. 28, 1877.	Day after Sailing day Monday, March 5, 1877.
Tower Side.		
The number of Steamers	7	11
Vessels with fixed masts	17	20
Barges without masts, or with masts that can be lowered	32	44
Surrey Side.		
The number of Steamers	5	11
Vessels with fixed masts	27	19
Barges without masts, or with masts that can be lowered	84	104

Giving a total of 34 steamers, 83 masted vessels, and 264 barges in the Upper Pool.

Dividing these quantities by 2 to get the mean for one comparatively quiet day, there remain 17 steamers, 41 masted vessels, and 132 barges.

The average length of steamers was about 150 feet whilst the greatest length was about 260 feet. The masted vessels averaged 80 feet in length. Vessels east of the line of Irongate Stairs are not included in the above list.

To test the capacity of Mr. Barnett's bridge, the author assumes that a larger number of vessels have to be provided for than stated above, as he understands as many as 72 steamers and masted vessels have passed into the Pool, and 24 passed out, during one tide.

This brings the total up to 96, and it is this number which should be applied as the test.

Assuming for argument's sake the greatest and most favourable width of loop for the passage of ships, say 200 feet, allowing the swingbridges to work clear of their masts (See Plate 4), and placing four vessels, one averaged sized steamer and one schooner in each of the two passages—twenty four swings to open and shut the roadways would be needed to dispose of the traffic—these motions, calculated at 44½ seconds each swing at either end, would occupy 35 minutes 12 seconds.

The time occupied by the set of four vessels entering and taking up their positions before the last gate-bridge was swung would, with two vessels in each passage, that number necessitating most careful handling, occupy about five minutes each set or two hours in all, bringing the actual total time up to 2 hours 35 minutes 12 seconds.

On March 1st the following observations were recorded by the author on the Thames Conservancy tide pole fixed alongside London Bridge.

Time, P.M.	Rate of Current Knots per Hour.	Feet.	Inches.	
2.40	1¼	1	2	*above* Trinity high water mark.
2.50	1⅛	1	6	,,
3.0	1	1	10	,,
3.5	⅞	1	10½	,,
3.10	¾	1	11	,,
3.15	¼	1	11½	,,
H.W. 3.21	0	2	0	,,
3.35	½	1	10	,,
4.45	3	3	2	*below* Trinity high water mark.

The above tide was a somewhat unusually high one, such as might and actually does occur, so far as height is concerned, some ten times, and as regards rapid rising and falling with little or no slack water, 50 times, in the year. It will be remarked that the level shifted 4ft. 4in. in 2 hours 5 minutes, and it must also be particularly borne in mind that the tide pole is fixed in comparatively slack water, within a few feet of the shore, and that the current observations in no way represent the rate of current running directly mid-stream, where the speed is about twice as great. The table gives positively little or no slack water, the only working time being from about 2 hours 40 minutes, to say, 4 o'clock; or, 1 hour 20 minutes, which time should, in rightly estimating the position of Mr. Barnett's central openings due to currents, be reduced to about three-quarters of an hour each tide, less than one-third the time needed on special occasions; and, consequently, totally inadequate to meet the exigencies of the trade.

Passing on to the great and valuable mid-channel water space, which a central basin must necessarily occupy, it will be seen on referring to Plate 4, that Mr. Barnett's drawing shows three vessels—240, 150, and 60 feet long respectively in the act of being passed through.

These three vessels can barely be accommodated so as to keep their masts clear of the swingbridges.

The bridges must be worked practically simultaneously, certainly within a few seconds of each other, if the two ship passages are to be used at the same time, allowing no opportunity (even if it were desirable) to shift the position of vessels, before they make their final move from the basin.

Lastly, the central basin plan deprives unmasted boats and vessels of the readiest means of passing up and down the river.

Mr. Barnett's basin in reality occupies the entire river between the lines of ordinary low-water springs. The consequence would be, if his plan were adopted, that river steamers could only pass through either of the along-shore openings at high states of tide, the openings being about 120 feet wide, one on either side of the basin.

River steamer traffic to and from Woolwich, Southend, Margate, etc., is an important element, and one that should not be left at the mercy and risk of tides and collisions, for if these lightly-built steamers cannot, for want of water, pass under the side archways they must necessarily pass under the double roadway of the mid-channel area. This means shooting the rapids through either of the two 50 feet wide passages, for a distance of nearly 400 feet, a task that can only be attended with very considerable danger.

Mr. Smiles, the historian, in quoting old London Bridge, says:—" The feat of '*shooting the bridge*' was in those days attended with con-" siderable danger, and lives were frequently lost in the attempt." The current would run seaward 7 knots an hour, with proportionately higher rates of speed during excessive rainfalls. This rate of travel vividly recalls to the author's recollection the shooting of the Higher Yang-tse-Kiang rapids, where the slightest deviation from mid-channel course meant destruction to all on board.

Mr. Barnett's cross-section (Plate 4) shows how difficult it would be to pass through the proposed central loop with safety a body of swift-running water considerably greater than the two artificial openings can accommodate. It is certain that the authorities will not countenance so open a courting of the probable loss of a large number of lives annually.

PALMER'S PROPOSED TOWER BRIDGE.

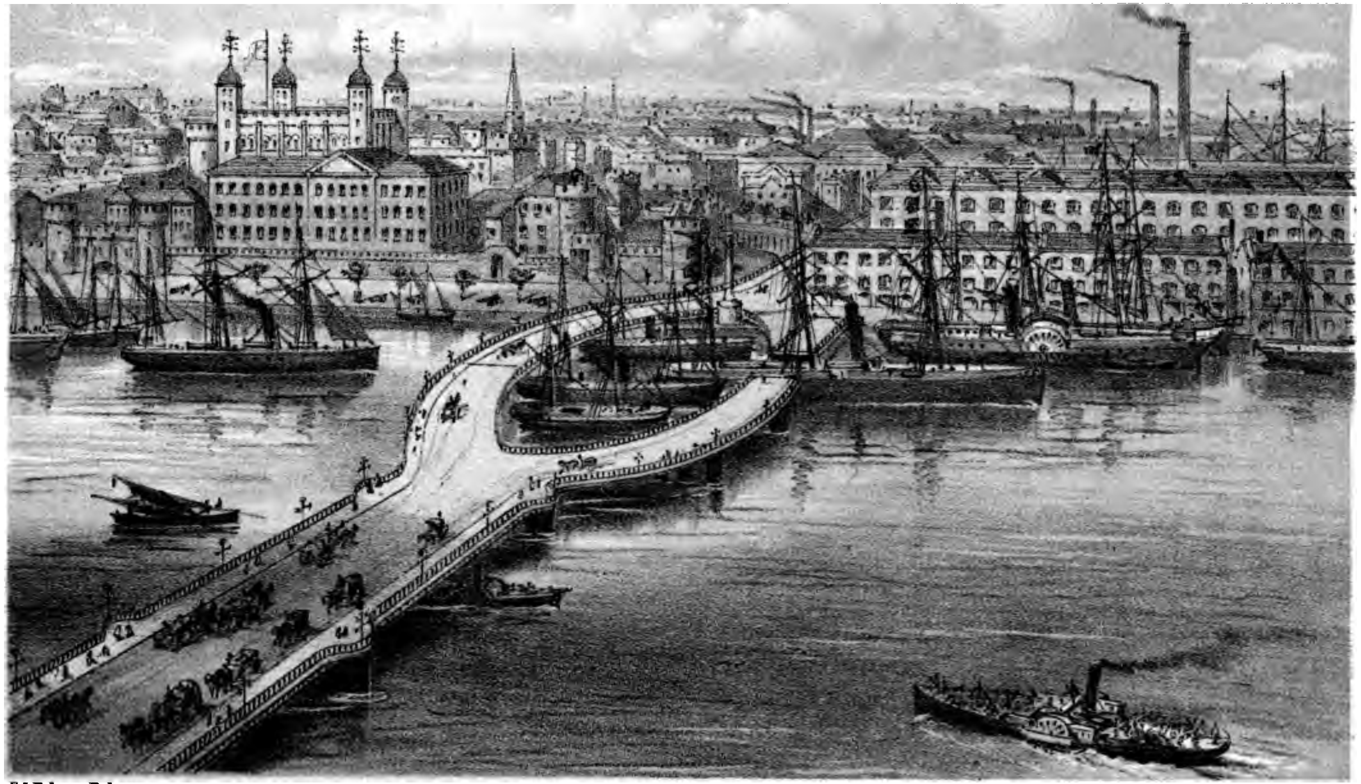
A general view of the author's bridge is given in Plate No. 2, and the reader is referred also to Plates Nos. 1, 3, and 4 for further details of it.

The author has now to lay before the public his own plan for the construction of a bridge between Little Tower Hill and Horselydown Stairs. It is the fruit of much consideration of the varied interests at stake, and he invites free criticism on it, believing that the more minutely it is examined the freer it will be found from those defects which have prevented the adoption of any of the plans hitherto brought forward.

It may be briefly described as an adaptation of General Bentham's principle of the double drawbridges, with the essential difference that two sets are employed—the enclosed basins being in the slack tide-way on each shore—leaving the centre of the river clear for barge and above-bridge steamboat traffic.

PALMER'S BRIDGE WITH SHORE BASINS.

Plate 3.



F. I. Palmer. Del.

C. F. Kell. Lith 8, Castle S^t Holborn E. C.

THE PROPOSED TOWER BRIDGE FROM WEST SUMMIT OF BUTLER'S WHARF.

To carry out the plan the author proposes to dredge the foreshore on the site of the basins to the same depth as the fairway channel in the centre of the river. The dredging commences at the edge of the channel a short distance above and below the basins, and is carried towards them, so as to make a funnel shaped entrance.

This form of the river bed induces a diminution of tide around the basins, and places the vessels when about to enter—the most critical time—in most favoured positions under the lee of the natural banks behind them.

Another important advantage of the author's plan, as compared with all others, is that the waterway occupied by the piers of his bridge is much more than compensated to the river by dredging the side channels, and this assists materially to diminish the flow of the current through the bridge. The entrances into the basins will be 60 feet in width, which allows ample working room for ships to pass in and out.

They will be opened and closed by sliding drawbridges moving to and from the shore at right angles to the line of river, worked by hydraulic or other machinery placed on the inshore side of each basin.

Presuming the bridges are moved at the rate proposed for Mr. Barnett's swingbridge, each operation will occupy a fraction over one-half of the time in opening or shutting, or 22¾ instead of 44½ seconds.

In the centre of the river there are two spans of 120 feet each (or if it is thought desirable one span of 250 feet may be substituted) for the passage of barges, and above-bridge steam boat traffic, which will thus have no occasion to make use of the basins provided for the larger vessels. Bearing in mind the present necessities of the traffic, and its future requirements, the author proposes to make the roadway of the single portion of his bridge (between the basins) 100 feet in width and each arm 60 feet in width.

The former dimension allows a 70 foot roadway, and a 15 foot pathway on each side, the latter a 45 foot road and a single off-side path of 15 feet, capable of comfortably accommodating, when the gate-bridges are closed, eight rows of vehicles abreast, four passing north on the west side of the bridge and four south on the east side.

During such time as vessels are passing through, accommodation would be restricted to five rows of vehicles only, giving a roadway ten feet wider than that now in existence over London Bridge.

From the nature of the curves no inconvenience can arise with the longest and most heavily laden timber team, as the line of sweep has been carefully considered in connection with the necessary form for the ship basin.

It will be observed, on reference to the plan, that the curves proposed by the author are much preferable to those shown by Mr. Barnett, and much more calculated to facilitate the working of the traffic.

As already stated, mid-channel currents run with much greater velocity than those passing along shore, where the frictional resistance due to piers, anchored vessels, and other obstructions is very great. There, therefore, seems to be no question as to the desirability of bringing the basins and their entrances as far beyond the influence of the main stream as possible, and thus to secure the longest working time for the passing of vessels through the bridge.

Assuming, however, for argument's sake, that the rate of flow alongshore and in mid-channel is similar, and taking the same number of vessels as he did in Mr. Barnett's case (viz., 96), the author will now compare the working time and facilities for getting them through in one tide—in, say, 1 hour 30 minutes—forty-five minutes on either side of slack water, when the rate of current mid-stream does not usually exceed 1¼ miles an hour.

To understand the matter clearly, the reader is requested to refer to Plate 4, which shows two basins, each comfortably holding four vessels, similar in size to those in Mr. Barnett's plan, the proportions being as eight to three.

The idea is that the rule of the road which exists mid-channel should be applied to these basins, consequently, inward-bound vessels would use the northern basin, and sea-going ones, the southern; thus avoiding all confusion and chances of collision, which must necessarily arise with shipping stopping and starting, if the two channels as proposed in Mr. Barnett's basin are only 50 or a smaller number of feet apart.

Divide 96 vessels by 4 and there remain 24 openings of the drawbridges to be performed on each roadway of the basins to admit and discharge masted traffic.

Divide this again by 2, as two basins are in this case proposed, and there remain 12 motions to be performed at each entrance.

Assume the width of these entrances to be 60 feet, and the time occupied in opening and closing these draws as 22 seconds each, one-half the time occupied by Mr. Barnett's swingbridge as the distance of travel is only about one-half, and we require 8 minutes 48 seconds for these motions.

Assume that a set of 4 vessels entering and taking up their positions before the last drawbridge was opened would occupy 5 minutes each set, and it brings the actual time required to 1 hour 8 minutes 48 seconds, considerably less than one-half of the time necessary in a basin constructed and situated as Mr. Barnett proposes.

In other words, it means that during the heaviest sailing days, only 34 minutes on each side of slack water would be needed, on the author's system, to effect a clearance of the Higher Pool.

This is not all, for his plan permits vessels to pass through with safety at any state of tide, provided, of course, that the side channels are kept dredged to the level of the bed of the river, and on the fair assumption that little or no tide will exist here, owing to the peculiar form and enlargement of the bed of the river, when a comparative mill-stream would be running through the channels of Mr. Barnett's basin.

Other important considerations in favour of the author's plan are to be found in the facts that the basins are so constructed that vessels need not, in the darkest nights, be delayed in passing through more than a few minutes, and that, from the employment of two basins, should one, from any cause or other, become temporarily disabled, the other is available for shipping.

To sum up, his scheme presents the following among other advantages:—

1st. The employment of two basins, separated by the width of the river, so that, if necessary, vessels can be passed through each simultaneously, without interfering with one another.

2nd. From the position of the basins inshore a comparatively slack current is secured through them, and the risk of damage to shipping or to the bridge is therefore reduced to a minimum.

3rd. From the foreshore being dredged to the depth of the fairway channel no waterway whatever is obstructed from the river by the piers of the bridge.

4th. The centre portion of the river is left free for the passage of barges and above-bridge steamers.

5th. By the employment of two basins the Upper Pool can be cleared of its shipping (on the very heaviest known sailing days) in 68 minutes, and this without the slightest interruption to the road traffic in the meantime. Lastly, no vested interests are interfered with, and no compensation will be needed for wharfingers.

BRIDGE APPROACHES.

The author thinks it will not be out of place to state briefly his views as to the approaches, which should be formed in connection with the proposed Tower Bridge; though he is well aware that, when the proper time comes, the subject of approaches will receive from the Metropolitan Board of Works and the City Authorities all the consideration and care its importance demands.

If the reader will turn to Stanford's library map attached to this pamphlet, he will observe that the great block in the City occurs through Fenchurch Street, Leadenhall Street, and Bishopsgate Street, being obliged to pour the whole vast and increasing traffic of the East-end into one narrow outlet, Gracechurch and King William Streets, before it can cross the river. It becomes a simple process to relieve this congested traffic by the proposed Tower Bridge, and further a very inexpensive one, provided that use is made of the existing northern approaches already formed from Bishopsgate

Street, via Houndsditch and the Minories, both wide thoroughfares, completely tapping the entire East-end traffic.

On the Surrey side a new street would be needed from the river's edge to the junction of the Old and New Kent Roads.

The northern line of direction is thought far preferable to a junction with the five great highways of Commercial Street, Whitechapel Road, Commercial Road East, Leman Street and Aldgate Street, as the passage of traffic there is already at certain hours of the day unusually heavy, and must, as London increases, become heavier and more difficult to control.

Again, it seems desirable to project a belt road from Houndsditch, in a north-westerly direction, between Finsbury Circus and Finsbury Square, rather than cut directly into Whitechapel Road in a north-easterly direction as has been proposed, which last line can afford but little immediate relief to the City proper.

One last point deserves a passing remark, and that is the junction of the northern end of the bridge approach with Little Tower Hill.

It is proposed to connect the bridge roadway with Little Tower Hill at a point some 600 feet from Irongate Stairs, and about 400 feet south of the Royal Mint entrance.

The bridge would be perfectly level throughout its entire length, and the gradient of the roadway approach from the Minories to a point, abreast of the West St. Katherine's Dock entrance, would remain as at present.

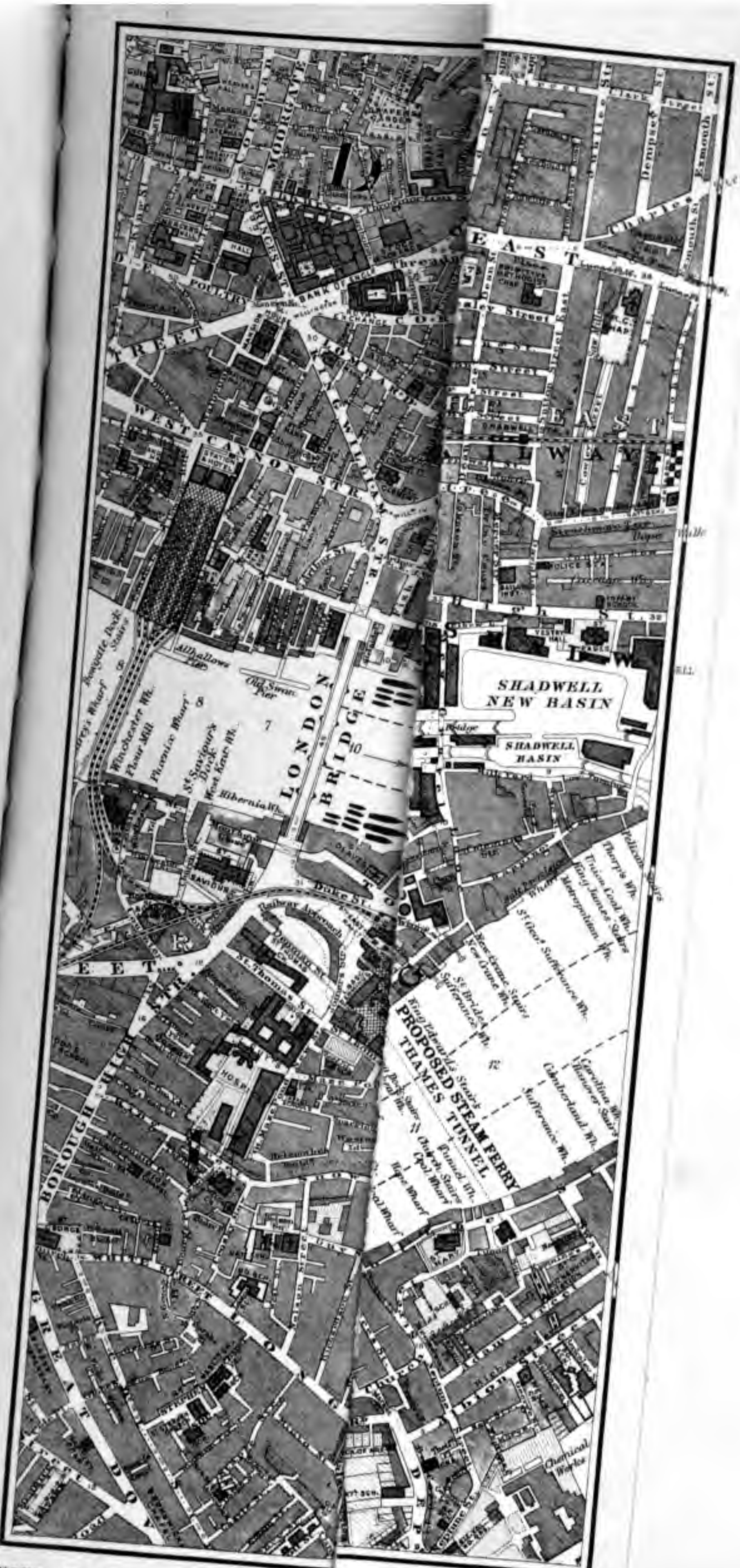
In considering the site for a new bridge it is imperative to understand and keep in control the immediate approaches to that bridge. In this instance St. Katherine Street abuts at right angles to the foot of Little Tower Hill, and sends out unusually heavy waggons from the Irongate and St. Katherine steam-wharves.

If the levels made it at all feasible to carry out direct communication between this street and the proposed bridge-road approach, it would be unwise to do so, as a combination of the street traffics at this salient point would cause considerable inconvenience and delay. Fortunately the difference of levels, some 18 feet, is sufficient to permit the passage of the St. Katherine Street traffic under the line of the proposed bridge, and so up along the west side of the bridge (see plates 2 and 4) on the gradient of the existing Tower Hill, until it reaches the level of and unites with the traffic at the bridge-road junction, as already stated, some 600 feet north of Irongate Stairs.

TOLL BRIDGES AS INVESTMENTS.

As an idea seems to be prevalent that the construction of a bridge east of London Bridge will be very costly, the author ventures to submit a brief sketch of what might be undertaken with seeming advantage to all parties.

Mr. Rennie's London Bridge cost £506,000, of which sum the Govern-



NOTE:_*The figures express the depth* *feet along Mid Channel at Ordinary Spring tides.*_ *Datum being 19'.8* *Trinity High Water mark.*

Tower Bridge with roads, thus

ment of the day contributed £192,000 from the Consolidated Fund, and there can be no doubt but that the present Parliament would co-operate generously with the Corporation, giving it the necessary powers and assistance in any scheme that they favour.

On referring to the accompanying map of the River Thames it will be observed that a true meridian line is drawn through the Metropolis at London Bridge; on the left of it there is a thickly-inhabited area of some sixty-two square miles, containing a population of about 2,600,000 people, united by fourteen bridges of all kinds; on the right, or seaward side, an area of some sixty square miles with a population of about 1,300,000 souls, having no connecting bridges, the only substitutes being a railway tunnel and the Tower subway. Of these 1,300,000 people it is believed that about 850,000 live in north-east and 450,000 in south-east London.

Mr. William Haywood, City Engineer, writing to the "Times" on 18th September, 1875, says:—

"I however, hold, and have treated fully of it in a report which I had "the honour to submit to the Corporation in 1869, that nothing but a new "bridge with proper approaches lower down the river will provide for the "present and rapidly-growing traffic—a traffic which augments to the east "of the bridge more quickly than in any other part of London. At the "present time one-third of the whole metropolitan population is to the east "of London Bridge, and it is this traffic which crowds the bridge and "approaches, and needs a new highway across the river.

"Much of this eastern traffic comes from long distances on either side "of the river, for the purpose of crossing London Bridge. I should say that "quite 8,000 vehicles daily would use a bridge lower down the river, and to "that extent would immediately relieve London Bridge; and for want of "such new bridge there must be some millions of miles of horse journey "made annually which might be saved."

The average number of foot passengers that cross London Bridge daily is some 105,000, whilst the vehicles number 20,000.

The Waterloo Bridge tolls are as follows:—

For every foot passenger	½d.
For every description of vehicle drawn by one horse or other beast of draught..	2d.
For each and every additional horse or other beast drawing..	1d.
For every horse, mule or ass not drawing	8d.
For every score of oxen or neat cattle	1d,
For every score of calves, hogs, sheep, or lambs	4d.

The Thames Steam Ferry Company estimate that the outlay required for their undertaking will amount to £56,360

That the annual estimated cost of working will be ... 11,300

That the annual earnings based on their proposed tariff will be 30,000

Leaving a net profit of 18,700

Mr. Barnett proposes to raise a capital of £352,000 to construct his central basin Tower Bridge, and to make it an exceedingly profitable investment, on the following scale of tolls :—

> " For every person on foot, the sum of *one halfpenny.*
> " For every horse, mule or ass laden or unladen and not drawing, the " sum of *twopence.*
> " For every horse or beast of draught drawing any carriage cart or " waggon, the sum of *threepence.*
> " For every carriage, the sum of *threepence.*
> " For every cart or waggon, the sum of *fourpence.*
> " For every bull, ox, cow, steer, heifer or calf, sheep or lamb, boar, sow, " pig, or other animal, after the rate of *sixpence* per score, and after " that rate for any greater or less number."

The present nine toll-bridges west of London Bridge return a net income of about £52,000, being an average of £5,700 per bridge, per year; whilst the total yearly repair of these bridges does not exceed £250 per bridge.

The Metropolitan Police District comprises all parishes within a radius of fifteen miles of Charing Cross. A halfpenny rate on the present rateable assessment of this District would produce about £60,000.

The rateable assessment, however, is in rapid growth, and this may fairly be considered in fixing the rate required if it be determined to provide the funds for the bridge out of this rate. It may also be assumed that the rate would in a period of 10 years cover the cost of the bridge, leaving it at the end of that time perfectly free.

If on the other hand this course of local taxation is objected to, and it is decided to provide the money by a system of tolls, it would, bearing in mind the report of the Toll Bridges Committee, "That it is most desirable " in the public interest, and especially in the interests of the labouring " classes of the metropolis, that the remaining toll-paying bridges should be " made free," be unwise to burden the poorer classes with additional tolls, as at present they are often obliged to leave in pledge small articles with the toll collectors when passing to and from their work.

The Committee further state that "the efforts of the poorer classes " to escape the tolls further leads to sanitary mischief. The thickly-populated districts on the north side of the Thames fail to obtain relief by " reason of the fact that many working men are content to occupy smaller " and more unhealthy habitations on the north side of the river rather than " cross a toll-bridge to a more open and sanitary neighbourhood."

To meet this serious difficulty, and to practically throw the bridge open free to the labouring classes, it is suggested that a foot-passenger toll should only be levied on week days between the hours of 9 a.m. and 4 p.m., or seven hours out of the twenty-four, to induce workpeople resident, and chiefly earning their livings on the north shore, to remove their residences south of the Thames, which arrangement would free the already overcrowded City, and at the same time improve the value of building property in the south of London.

Accepting, for illustration's sake, the sum of £352,000 for building a bridge (the figures given by Mr. Barnett in his Bill now before Parliament), and the City Engineer's figures as to the immediate number of passengers and vehicles that would be benefited by its construction, the result would be as follows from a financial point of view.

There would be 40,000 foot passengers and 8,000 vehicles crossing daily.

Allow one-half of the former to go free, and the other half to pay ½*d.* per head, and the vehicles 3*d.* each, and omitting Sundays, there remain 313 paying days, yielding a gross revenue of £44,341. 13*s.* 4*d.*

The annual working expenses would be approximately as follows:—

	£	*s.*	*d.*
1 Superintendent	500	0	0
8 Toll-collectors, average salary £120	960	0	0
3 Engine-drivers to work drawbridges, salary of each £150	450	0	0
2 Basin masters, salary of each £125	250	0	0
2 Assistants	100	0	0
Coal, oil, and stores	300	0	0
Fenders, stages, lines, &c.	100	0	0
Painting bridge	400	0	0
Making a yearly total of	£3,060	0	0
To this add interest on probable outlay of £352,000 at 4 per cent.	14,080	0	0
And there remains a yearly charge of	£17,140	0	0
Assuming the above net annual income of	44,341	13	4
There remains, after deducting all annual working expenses and interest on outlay, a clear profit of	£27,201	13	4

This arrangement, based on the above small return of traffic-paying tolls, would free the bridge in twelve years, while it can be unhesitatingly predicted that, allowing for the increase of population and the traffic developed by the new route, it would pay its cost in nine years.

Notwithstanding this, however, the author is of opinion that the true policy of the authorities is to make such financial arrangements as will enable them to declare the bridge free to the public from the date of its opening.

The author has endeavoured to lay before the public in as concise a form as possible his views on the two questions of the prevention of floods in the Thames Valley and the relief of London Bridge. In doing this he found it necessary to omit many details which, though interesting to engineers and others intimately acquainted with the subjects discussed, would be in his opinion out of place in a pamphlet such as the present. All of them have, however, received due consideration at his hands, and none of them in his opinion present any difficulty in the carrying out of his scheme.

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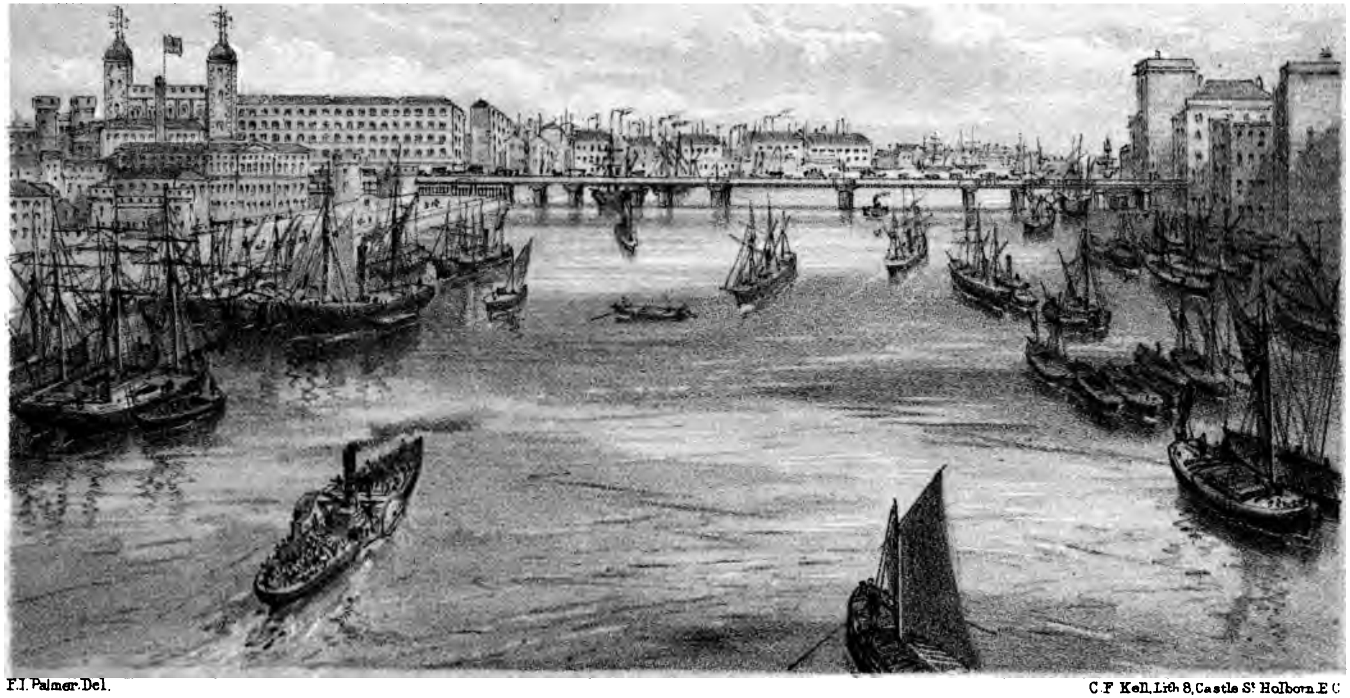
* The present congested state of the traffic on and about the immediate northern approaches to London Bridge has obliged the numerical strength of the police force on duty to be nearly quadrupled during the past twelve years. By passing this traffic over the Thames somewhere near the Tower, instead of over London Bridge, a reduction in the police budget to the extent of several hundreds of pounds annually would be at once effected.

THE END.

29th March, 1877.

PALMER'S BRIDGE WITH SHORE BASINS.

Plate 1.



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THE PROPOSED TOWER BRIDGE FROM LONDON BRIDGE.

OPINIONS OF THE PRESS.

"TIMES," *September 25th*, 1875.

WITH respect both to London Bridge itself and to the convenience of metropolitan traffic the problem is one of the first importance, and it would be most unsatisfactory that it should be settled upon the very meagre Report which the Committee of the Common Council had before them. It ought to be considered from far more extensive points of view, and with due regard to the permanent, as distinguished from the temporary, interests of the City.

There can be little doubt, for instance, that the project of Mr. Haywood for the construction of a new bridge lower down the River deserves, at all events, most attentive consideration. If, as he alleges, such a bridge will some day become absolutely necessary, it is evident that any money spent in widening the existing bridge will be thrown away. The apparent economy at the present moment of spending only £55,000, instead of undertaking the vast cost of a new structure, is purely delusive if the new structure must, after all, be made. Of course, it is much easier, and, we fear, too much in accordance with some of our national habits, to resort to every minor expedient before facing the ultimate necessity of the case. But the Corporation of London ought to be capable of bolder counsels. We do not say that Mr. Haywood is right, but he has certainly advanced strong reasons for his opinion, and the public will have reason to be dissatisfied if they are not maturely weighed. The essential cause of the obstruction of London Bridge lies, as we observed the other day, in the fact that it is the only roadway across the Thames for the vast metropolitan area which stretches eastward from the City both to the north and south of the River. The passenger traffic may, indeed, in some measure be accommodated by boats or ferries; and a steam ferry from Wapping to Rotherhithe will shortly be established. But all such schemes, however useful in their way, are mere palliatives, and the great mass of carriage traffic will always pass over the nearest bridge. . . . .

It was calculated a quarter of a century ago, in evidence before a Commission, that the loss then incurred in carriage traffic alone on Holborn and Ludgate Hills represented £100,000 annually.

Such an estimate can bear no comparison with that of the loss which must be suffered by forcing vehicles from the south-east and north-east of the Metropolis to go miles out of their route in order to cross London Bridge.

There seems good reason for believing that, whatever the apparent cost of a new bridge, it would really be the cheapest mode of relief when all the interests concerned are taken into account; and in carrying out a scheme thus benefiting a large part of the population of the Metropolis, the City might reasonably expect to be not left alone in bearing the expense.

"TIMES," *October 8th*, 1875.

MR. TEEDE thought the Court was much indebted to Sir Thomas Dakin for bringing the subject forward, if it were only for the opportunity it had afforded for setting themselves right with the public. It was, however, not a wider bridge that was required, but more bridges, considering that a million and a half of people lived east of London Bridge, without taking into account the St. Katherine and West India Docks, and the enormous amount of traffic in the neighbourhood of the Tower. He dwelt on the care with which the whole matter had been considered by the Committee, but still he was of opinion that nothing else would obviate the existing inconveniences but a new bridge over some other part of the Thames. . . . .

Supposing a bridge lower down the River would cost three millions of money, a tax of sixpence a ton on coals would enable the corporation to build a bridge, with all the necessary approaches, and pay off the whole attendant cost in forty or fifty years.

"TIMES," *December 17th,* 1875.

MR. M'GEORGE gave notice of the following motion :—"That the Bridge House Committee be authorised to spend a sum not exceeding £1,000 with a view to a thorough examination of the various schemes submitted to the Court for the relief of the traffic over London Bridge;" and Mr. H. A. Isaacs of the following :—"That, in order to meet the wants of and to relieve generally the continuously increasing traffic of the City, it be referred to the Bridge House Estates Committee to consider and report as to the desirability and the approximate cost of erecting a bridge over or a subway under the Thames east of London Bridge, and that the Committee be authorised to confer with Her Majesty's Government upon the subject."

THE AUTOBIOGRAPHY OF SIR JOHN RENNIE.

The details of the construction of the piers of London Bridge, penned as they are by the designer, are of great professional interest, and the peculiar conditions under which the bridge was built render it of more than usual importance, while the successful way in which all the difficulties connected with the old bridge and the powerful scour at this part were overcome, proclaim Sir J. Rennie as the king of bridge builders.—*English Mechanic, November 19th,* 1875.

"TIMES," *February 4th,* 1876.

MR. HENRY A. ISAACS contended that he had proved that the widening of the structure was undesirable and unnecessary. He now suggested that they should, as means of relieving London Bridge, provide some additional means of communication between the two banks of the River. The thoroughfares of the City of London were in a fearfully crowded condition, and, indeed, he knew of no city in the world which fared so badly in respect of the number and the size of its great thoroughfares. All the traffic to and from the wharves on both sides of the River, extending on the north to Blackwall and on the south to Woolwich, had to pass across London Bridge, and thus served to increase the already overcrowded traffic of the City. He contended that to save the wear and tear of men, horses, and roads, and to economise time, which meant money, they must cross the river lower down. In conclusion, he said he did not ask them to commit themselves to the construction of a bridge or a subway, but he wished them to refer the question of the advisability of providing some additional means of transcommunication to the Bridge House Estates Committee for consideration and report.

Mr. W. S. Gover, in seconding the motion, pointed out that all the congestion of traffic was occasioned east of London Bridge, and that if a new bridge were carried across the Thames at Tower Hill it would instantly relieve the traffic on the existing structure and its approaches. Such an undertaking as that would not necessarily be borne by the Corporation alone, but towards its cost the Bridge House Estates, the City's cash, and even the Consolidated Fund, might make contributions. * * * * * It is asserted that any widening of the bridge would only complicate the confusion, unless the approaches to King William Street were also enlarged. It remains, then, to be seen whether traffic can be diverted from London Bridge in any other direction. Something might be done by improving the approaches to Southwark Bridge. Much more might be done if it were possible to construct a new bridge farther down the river. Many schemes for such bridges have been put forward, but nearly all are open to the objection that they would interfere with the shipping which now comes up to the great warehouses along the river side. This commerce must not be interrupted for the sake of uniformity or individual convenience. It may be that a bridge which will not interfere with Thames shipping can be constructed; the engineering art is less helpful than it ought to be if no such thing is possible.

"TIMES," *December* 15*th*, 1876.

YESTERDAY a meeting of the Court of Common Council was held at the Mansion House for the despatch of business, the Lord Mayor presiding. An important report was brought up from the Special Bridge and Subway Committee by Mr. H. A. Isaacs, the Chairman. * * * * * The Committee had very fully and carefully considered that most important subject, and, after mature deliberation, they had arrived at the conclusion that, provided the requisite funds could be obtained for the purpose, it is desirable that a bridge over, or a subway under the Thames should be constructed eastward of London Bridge, and that the most eligible site will be that approached from Little Tower Hill and Irongate Stairs on the north side, and from Horselydown Lane and Stairs on the south side of the river. They recommended that it should be referred back to them to consider the best means of carrying the same into effect, and of procuring the requisite funds for the purpose, and they further suggested that they should be authorised to advertise for designs, and to offer premiums for those most approved.

THE Right Honourable Mr. Ayrton when addressing the Company after the launch of the "Jessie May," one of the Thames Ferry Steamers, goes on to say :—
"In considering how to relieve the centre of the Metropolis of that enormous crowd "of traffic, that day by day was increasing, it was natural that the first idea should "be that if London Bridge was enlarged the necessary accommodation would be "provided; but he was happy to find that the Common Council had arrived at a wiser "and larger conclusion, namely, that merely enlarging the bridge would only in"crease the difficulties of the traffic unless the approaches also were enlarged, and "also those narrow streets—the remnants of former centuries—by which those "approaches were reached. Money so spent would be a waste of public resources, "and they were therefore applying themselves with intelligence and energy, and he "had no doubt ultimately with success, to find some new means of communication. "He thought they were indebted to the Lord Mayor for his presence, and for not "regarding the ferry scheme as a rival to any project of the Corporation, but rather "as an auxiliary which would deal with a part of the Thames beyond the sphere of "civic jurisdiction, and beyond the scope of their operations. That showed an "intelligent view of the present state of the question."

"CITY PRESS," *December 23rd,* 1876.

ALDGATE.—This wardmote was held at the Ward School Committee-room, Alderman Sir A. Lusk, M.P., presiding. There was a large attendance.

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THE TRAFFIC OF THE CITY.—Mr. Horner expressed a hope that these members would use their utmost endeavours to secure a new bridge east of London Bridge.

Mr. Burnell said he had always reprobated unnecessary expenditure by the Corporation. He had felt that a bridge east of London Bridge was a necessity, and he should do all he could to bring about its erection. It would be a profligate waste of money to spend anything on the enlargement of London Bridge. He had called the attention of the Corporation to the desirability of the western end of Fenchurch Street being widened so that the traffic of Aldgate might be facilitated. There was a difficulty in preventing the renewal of leases, but where there was a necessity for it he should not shrink from urging the adoption of such a course.

Mr. Isaacs observed that he and his colleagues had not intended to be disrespectful to the electors in not communicating with them by means of separate circulars. As to the new bridge he was not quite certain whether that would not have to give way to a subway. ("A bridge.") The question would have to be settled elsewhere. It was obvious that there was a necessity for increased communication between the two sides of the river east of London Bridge, and the question should have his best attention.

* * * * *

BLOCKADE OF THE STREETS.—Mr. F. Besley said he had a very serious complaint to make of their representatives, inasmuch as they did not seem to be doing much towards preventing the hindrances to trade through the stoppages in the vehicular traffic, and the long blockades of streets. It was all very well for gentlemen to aspire to represent the ward and eat the dinners at the various festive boards, but it was a great loss to the tradesmen when their representatives went to sleep. The manner in which the interests of the ward were kept back for want of active measures to make better street accommodation was a disgrace. There had been a large amount of capital invested by the tradesmen of the district, and much money also spent upon the new fish market, and for the fruit trade; but what was the use of all this outlay when the streets were kept so narrow as to restrict and positively impede the trade? All their officials were well paid, and the City Architect especially received a very large salary to look after the interests of the place, but whilst the people of the West-end were continually having improvements, and considerable professional assistance, the representatives of this ward and the people of the East got very little. He believed that what was wanted to relieve the blockades of those streets, and thus do away with the hindrances to trade, was a railway down to the place. If they had the new bridge that had been proposed, he thought it would militate against their interests, because it would take the trade further down. (Cheers.)

Sir H. W. Peek, M.P., said he quite agreed with much that had been said by the previous speaker. He considered that the tradespeople of that ward had very great grounds for complaint. During the last forty years the matter had been bandied about from one committee to the other, till the people generally had become thoroughly dissatisfied and surprised that nothing had been done. He was of opinion that against the Corporation at large this ward had very great ground for complaint. It was quite true that enormous sums of money had been spent westward, whilst the East had been almost neglected. He might say that millions had been spent westward, whilst the East had been kept in a chronic state of disappointment; and it appeared to him that they were likely to be kept so. He had taken the liberty of writing to the Lord Mayor to express his dissatisfaction, and if things were to go on as they had done, he should long to see the day when the works of that district would be handed over to the Metropolitan Board. It really appeared to him very strange that a ward like theirs, in which there were so many important and valuable interests, should be so long neglected. They had in their district the fish market, the fruit market, the colonial produce trade, the corn market, the wine trade, the Tower, and the Mint; the traffic to which all came along Eastcheap, which was no wider than it was thirty years ago. Not only was the ordinary vehicular traffic constantly stopped, but he had seen the royal carriages blocked; the troops blocked, and even some of the men knocked down by the porters so numerously employed. He himself was knocked down the other day; and thus, considering the crowded state of their streets, and the serious loss to the tradesmen of the place, he was of opinion that they had real grounds for the gravest complaints. When he went to the various City offices he constantly saw a large number of places for sale, and he could not see why many might not have been bought for City improvements. If he had been in the West and had seen so many opportunities for improvement as he had seen here, he should have gone to Sir W. Bazalgette or Sir James Hogg, and he would have been listened to and would have had an answer; but if they went to the committees in this district they got no answer at all. He had often been taunted with being by his business partly the cause of some of the blocks. He could not see that he was more so than many of the other dealers in this ward. These blocks, however, were on the increase, and a source of complaint throughout the City. Mr. Samuel Morley had had to complain very much of the block in Wood Street. He was asked when he complained whether he could suggest a remedy, and his reply was that if a remedy were not soon provided, a large amount of the trade would soon be driven out of the City.

* * * * *

Mr. Hanson said they had done what they could. The Improvement Committee had drawn up a report in reference to the best way to relieve the traffic of the district. He read the report, which ended by stating that, "Having given to the subject our most anxious attention, we fully recognise the very serious and growing difficulties resulting from the crowded state of the thoroughfares in the ward of Billingsgate." * * * * The speaker, continuing, said that when the new market was opened it would be found necessary to have an approach to it. If they did not they would be in the position of a man who had built a house and had no road to it.

* * * * * *

THE NEW MARKET.—Mr. Bell said that the new market was approaching completion and would provide increased accommodation. Whilst the old market only covered 20,000 superficial feet, the new one occupied a space of 39,000 superficial feet. * * * * There had already been £126,000 spent upon it, and £26,000 more would complete it.

* * * * * *

RENEWED AGITATION.—Mr. Shepherd Scott said he had an important motion motion to bring forward. He would have done so last year, but was prevented by absence. He, however, would never leave the subject as long as he was here till the work he was about to allude to was accomplished. He was glad to say that their deputy had ever been ready to second every requirement of the ward, and had always done so not only willingly but ably. He wished to direct their attention specially to the fact that this ward is exactly in the same position as it was immediately after the great fire of London in 1666, with this exception that the people had not then the very heavy expenses the inhabitants of the ward now have. * * * * For 40 years now there had been an agitation going on by petition after petition, and deputation after deputation, to the Court of Common Council, to endeavour to get a remedy for this state of affairs, and it was now with surprise and indignation that they saw little probability of anything being done to relieve the blocked approaches to the river. The present alderman, he believed, was the senior alderman, and it would be within his recollection that many of the merchants there had lived over their places of business, but so great was the increase of business, that it was found utterly impossible to carry it on as it ought to be, and keep pace with the natural requirements of an extended trade because of the bad street accommodation.

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Mr. Ridley also thanked them, and observed that the great addition to the commerce of the City means more work for the members of the Corporation. Year by year things were cropping up on account of increasing population and traffic, which engendered heavier responsibilities. * * * * With respect to the increased traffic and the question whether a bridge or a subway should be put more eastward of London Bridge; no doubt a great relief would be afforded to the traffic of the City if a communication across the Thames eastward could be effected. There was also the question whether London Bridge should be widened or the new bridge made. There could be no doubt if it was possible to make the bridge lower down it should be done, and, if necessary, London Bridge widened also.

"Builder," *December 30th*, 1876.

If we average the day at twelve hours, and consider that all the traffic of London Bridge is equally distributed through those twelve hours (which is a very rough approximation to fact), we find that 1,596 vehicles, and 8,696 foot passengers cross every hour. Of these it is estimated that 30 per cent., or nearly 500 vehicles, and 2,600 passengers, would be diverted to the new eastern bridge. But we shall very much undervalue the service which the proposed communication is likely to render to the metropolis if we credit it only with the traffic which it may abstract from London Bridge, It would create, if placed at a suitable spot, a large traffic of its own—a traffic that in all probability would soon equal that which it was at first calculated to divert. Then if we consider how traffic is concentrated at certain hours, we shall find that no engineer would be justified in undertaking a costly work of a permanent nature for the accommodation of the eastern traffic which should not be capable of transmitting a current of at least 800 vehicles and 4,000 passengers per hour in each direction through the busy time of the day. This is far beyond the capacity of either of the proposed hydraulic-lift bridges, and is an additional indication of the fact that it will be wiser for the City of London to look to a permanent bridge, regularly approached, although it may have a million to pay for it, than to endeavour to save expenses by any hitherto untried expedient.

"The Inventor," *January 17th*, 1877.

Mr. Barnett's Proposed Tower Bridge.

It was considered advantageous that the bridge should be free of toll for foot passengers, as by this concession opposition to the Bill in Parliament would probably be avoided; though it is proposed for vehicles drawn by one or more horses to establish a toll of sixpence. This charge on 8,000 vehicles would produce £200 daily, £1,200 for six working days, or £62,400 per annum, which amount will naturally increase as the new direct roads are opened to the south-east and south-west of the metropolis, shortening the communication between the counties on each side of the Thames. According to Mr. Barnett's calculation, based on the published statistics of the City Engineer, the same would yield a revenue sufficient to pay a dividend of 10 per cent. on the required capital to build the bridge. The engineers, Messrs. Le Fevre and Co., estimate the cost of the new bridge at £250,000, and state that it could be completed in two years. They are now in communication with the engineers of the Board of Trade, the War Department, the City, and the Metropolitan Board of Works, with a view to meeting all the requirements.

"DAILY TELEGRAPH," *January 26th*, 1877.

LONDON BRIDGE.—Alderman Sir Benjamin Phillips yesterday presided at a meeting of the Common Council, specially convened to discuss this subject. The Special Bridge and Subway Committee reported, recommending that, "provided the requisite funds can be obtained, it is desirable that a bridge over or a subway under the Thames should be constructed eastward of London Bridge, and that the matter be referred back to the committee to carry out the same;" and Mr. H. A. Isaacs, the chairman, in moving its adoption, said the committee, without considering the question of the approaches, had dealt with the subject of desirability, and thought, for the convenience of the traffic, a new means of communication with the south should be constructed eastward of London Bridge. Thirty per cent. of the heavy traffic would be benefited by the erection of the additional facilities, although of the light traffic and cabs not a single vehicle, if they were to believe the architect's report, would use them. The new bridge or subway, he (Mr. Isaacs) ventured to think, would be regarded as a boon to the thousands who would daily avail themselves of it. On the matter of approaches, the stoppages on London Bridge were traceable to their insufficiency. Once over the bridge, they were in Elysium. (Laughter). The committee would not for a moment recommend a bridge that would interfere with the river traffic, while the proposed site would embrace the way of the whole of the docks, and be on a line with Commercial Street. (Applause.)—Mr. Stewart remarked that the scheme of the committee highly pleased the merchants and ship-owners of the East-end.—Mr. Heginbothom, as an amendment, moved that the committee should be dissolved, seeing that their report did not appear to support the conclusion that their recommendations would divert sufficient traffic to justify the cost. The site of the new bridge, he pointed out, was not within the City, besides which a low level bridge would materially interfere with the traffic of the river, in the prevention of a fourth of the vessels landing merchandise in the port of London from doing so, while a high bridge or subway would be practically useless either for the gradients or the length of the approaches.

"DAILY NEWS," *January 27th*, 1877.

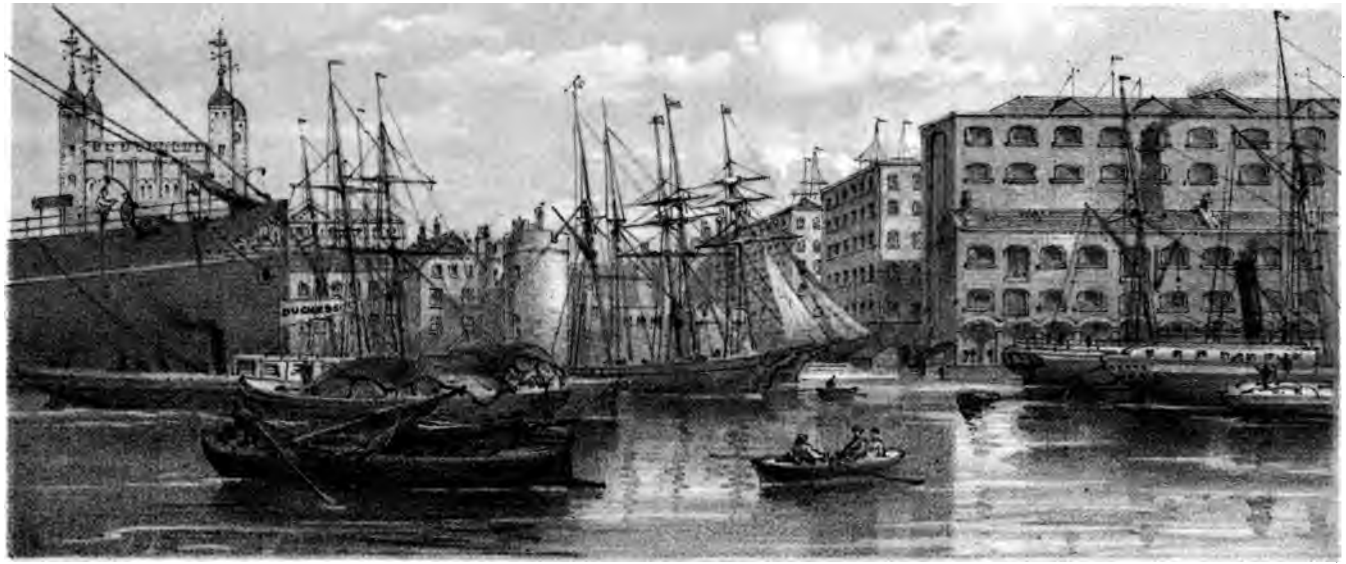
THE Common Council of the City has instructed its Special Bridge and Subway Committee to report further as to the means of raising funds for building a new bridge east of the Tower. This wise resolve is probably due to the fact that while the Corporation has been hesitating some enterprising persons have been endeavouring to take the matter out of its hands. Whatever plan for improving the communications between the two sides of the river is finally adopted by the municipal authorities, the sanction of Parliament will be needful; and it is therefore most desirable that Parliament should have before it some alternative scheme. If the Common Council had persisted in the proposal to widen London Bridge, any other method which seemed practicable would have a great advantage given it by contrast; and probably this consideration has weighed with the promoters of the Bill for a Tower Bridge. This Bill has this week been reported by Mr. Frere as having complied with the standing orders, so that the persons who are responsible for the undertaking are resolved to ask the opinion of Parliament upon it. The suggested bridge is marked in Mr. Stanford's Map of the Railways, Tramways, and General Improvements for which Bills have been deposited in the Private Bill Office for next Session. In this map the new bridge appears as a sort of Greek cross, with one arm pointing up stream and the other down, and two somewhat longer arms reaching to the river banks. As we understand its design, it will start with a wide road, which, about the fourth of the way across. will diverge into two, leaving between the two a wide lozenge-shaped open space of river, large enough for the biggest vessels which come up the stream. Each of these diverging lines would cross a swing bridge and then converge toward the other bank exactly as they diverged. When a vessel too large to go under the arches wished to pass, say up the river, the traffic going from the Tower side of the river would take the right-hand turning and go over the upper of the two swingbridges, while the lower of them was being lifted for the ship to pass in. When the vessel had safely got into the lozenge-shaped pool in the centre of the bridge, the lower swingbridge would be restored to its place, and the traffic would flow over it uninterruptedly while the other swingbridge was raised to allow the vessel to go on its way. By this method all interference with the free passage of ships, either up or down the river, and of vehicles across the bridge, would be prevented. A cabman would simply turn his horse's head to the right or the left according as the signal indicated that the way was open or closed. The Tower Bridge would, in fact, be duplicated in its middle portion, and one of the roadways would be always open, while the process of raising and lowering or opening and shutting the swingbridges would be so easy as practically to interpose the very slightest delay in the passage of the few large vessels which now use the wharves between London Bridge and the Tower.

We have described the proposal without venturing to express an opinion as to its feasibility. When the Bill comes before the Parliamentary Committee, the further information which will be elicited will enable the public to judge of its desirableness. The point chosen for the new communication across the river is beyond question the best. The Special Bridge and Subway Committee of the Common Council has recommended that a new bridge should be built, or a new and large subway constructed, from Little Tower Hill and Irongate Stairs on the north side, and from Horselydown Lane and Stairs on the south side of the river. The distance of the new structure below London Bridge would therefore be a little greater than the space between Blackfriars and Waterloo Bridges. The approach to it would be between the east end of the Tower and the western wall of St. Katherine's Docks, and the main thoroughfare leading to it would be the fairly wide street of the Minories. If a bridge were made at this point another wide street would have to be made in the long run to the corner where the Commercial Road runs into High Street, Whitechapel, or else into Leman Street. On the south side of the river the scheme includes the making of a wide road over the site of two narrow streets into the broad thoroughfare which the Metropolitan Board of Works proposes to construct by the widening of Tooley Street and other streets in the same line down to Dockhead, Bermondsey. The approaches to the new Tower Bridge would even then be incomplete on the south side. Probably, if the Bill were passed, and the construction of the bridge authorised, the Metropolitan Board of Works would see the desirableness of making a new street from the end of Long Lane and Bermondsey Street to the riverside, instead of widening Bermondsey Street, which turns off in the direction of London Bridge, and needs enlargening now because all the traffic goes to the point at which alone it can cross the river. The Special Committee of the Common Council, though it fixed on the same points as the promoters of the present Bill for the Tower Bridge, expressed no approval of the scheme itself. It had sat from February to December considering the question; and having decided on the point at which the new passage across the river ought to be made, asked to be appointed again to consider the means of carrying the proposal into effect, and this request has been granted.

Some members of the Corporation still cling to the resolution come to on insufficient consideration, and afterwards suspended, to widen London Bridge. It is scarcely worth while to point out the undesirableness of this plan. Almost every authority has been against it; public opinion has discouraged it; and there seemed to be no chance of Parliament consenting to it. Whether a half width of new bridge were built on at one side, or the footways were made to overhang, the best authorities seem to agree that the present structure would probably be endangered,

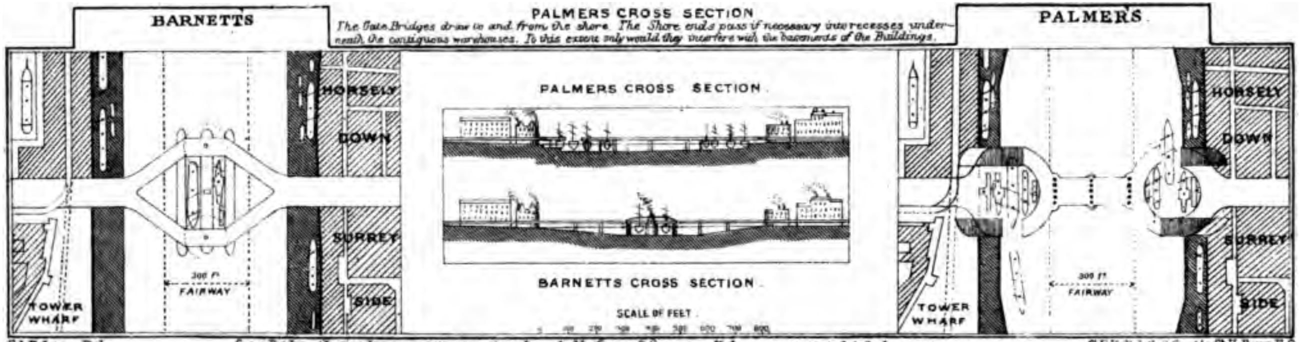
IRONGATE STAIRS FROM THE SURREY SHORE.

Plate.4.



PALMERS CROSS SECTION

The Gate Bridges draw in and from the shore. The Shore ends pass if necessary into recesses underneath the contiguous warehouses. To this extent only would they interfere with the basements of the Buildings.



F. I. Palmer. Del.

Swing Bridges with circular movements seem the only workable forms of Gateways. If they are constructed in halves to open one section on either side, the length of the Channel would be so increased as to make the passage of Vessels a still more dangerous operation.

BARNETTS CROSS SECTION

C. F. Kell. Lith. 8 Castle St. Holborn. E. C.

while the slightest observation proves that if the bridge is widened, the width of all the approaches must be equally increased. The plan of putting iron arches of a different span as supplementary to the present arches, has already been carried out with hideous results on one of the bridges of Paris; and if any Common Councilman who still favours this preposterous scheme will take a steamer on the Seine, and go eastward from the Cité, he will speedily see the ugly example of what London Bridge must by no means be made. If, however, the obvious necessity of the case is met by a new bridge lower down the stream, the mistake must be avoided of allowing it to be erected by a private company. We know nothing of the promoters of the Tower Bridge Bill, nor of their objects, but the measure is at present in private hands. It is not promoted by the Metropolitan Board of Works, and it is certainly not favoured by the City Corporation. If the bridge is made, it must be done by public authority and by public funds. The ratepayers of London will have, in a very few years, to incur a liability of something like a million and a half in freeing the present toll-bridges; and on no account must Parliament permit the erection of another. A toll-bridge at the Tower would be less useful than Waterloo, and would do less to relieve London Bridge than that splendid but half-deserted structure does to relieve Blackfriars and Westminster Bridges. The promoters probably desire that the public authority should take the matter out of their hands, but whether that is their object in pushing the bill or not, Parliament will not be likely to leave the work to them, if it sanctions their scheme. Bridge-building can no longer be a private speculation in London; it is a matter in which the convenience of the whole metropolis has to be considered, and in which nothing must be done except by public authority. The new bridge, if there is one, must be built at the public expense, and be thrown open for the public use; and it is much to be hoped that the Committee to which the subject is now referred will be able to suggest the means by which the necessary funds may be raised.

"CITY PRESS," *January 27th*, 1877.

A CONVENIENT bridge or subway would be used by hundreds. The dirty Tower Subway was used by hundreds daily. There were thousands on one side of the river who had to earn their living on the other side, to whom sixpence per week was an important matter. They had some claim to be relieved from this by reason of the Corporation having been instrumental in freeing the toll-bridges higher up the river. The Thames Embankment was a great improvement, but it displaced a large amount of wharf property. The effect of this had been to concentrate the business of the wharfinger further east, and the greater was the necessity for a new bridge or subway, as recommended by the committee. He justified the site selected, and denied the assertion that had been made, that a new bridge would interfere materially with the river traffic.

"DAILY NEWS," 19*th February*, 1877.

THE Metropolis Toll Bridges Bill is the result of a very long negotiation and a compromise. It was dropped last year because the ex-Lord Mayor opposed it in the supposed interests of the Corporation of London, and there was not time to force through against civic antagonism. An important inquiry had been held by a Select Committee to which the Bill was referred, and which reported in its favour. The City Corporation wanted to have some share in the work of freeing the remaining bridges, in accordance with the precedent set in the Act under which Kew, Richmond, Staines, and other bridges have been freed at the cost of the people of London. The bridges to be relieved from toll are, however, with the single exception of the footway over the Cannon Street Railway Bridge, within the district of the Metropolitan Board, they will be paid for by the whole of London, and there seems to be no reason why Sir James Hogg and his colleagues should not have the management of the business. Bridge-building, by the old law and custom of England, is county work, and as these bridges do not lie within the area of any municipal borough, it is the duty of the counties of Surrey and Middlesex to take them in charge. They have, however, been built by private persons, and are, as a rule, bad speculations in a pecuniary sense. It is proposed that the Metropolitan Board of Works shall borrow about a million and a half of money, and buy out all the existing proprietary interests in these bridges, and shall throw them open to the public. The debt thus incurred will be paid off with interest in fifty years by the ratepayers of the metropolitan district, and the counties of Surrey and Middlesex will each contribute in perpetuity a sum of twelve hundred a year in full discharge of the county liability to maintain and repair them. The bridges will thus be the property of the Metropolitan Board of Works, in trust for the ratepayers, and will be kept up as public works. The cost to the ratepayers will be inappreciable, and the relief to the traffic of London will be immense. The chief benefit is to the poor, as may be seen in the case of Waterloo Bridge. The West Central District of London is connected by this route with the Surrey side, and thousands of persons employed in shops and warehouses in the Strand, Holborn, and Oxford Street, and the busy district around them, might live in the cheaper houses on the Surrey side, only that the toll is a serious addition to their rent. The effect of removing the toll will be to open the way out of a crowded district to many poor persons who will be glad to get into the ampler space south of the Thames. In this way the freeing of the communications of a great city aids in the natural and healthy distribution of the population.

Most of the bridges affected by this measure are west of the City. Beginning at the west the first is the Hammersmith Suspension Bridge, all those higher up the stream to Staines have been freed already. The other bridges are those at Putney, Wandsworth, Battersea, the Albert Bridge, the Chelsea Suspension Bridge, Vauxhall, Lambeth, and Waterloo Bridges, and the footways beside the railways from Charing Cross and Cannon Street. Deptford Creek Bridge, which was included in the old Act, but which was not bought because the funds fell short, is included in the new scheme. It may be hoped that if at length this Bill is passed, and as the result of many years of agitation the metropolis gets free communication between the banks of its great river, Parliament will not any more sanction the erection of bridges by private companies. Some further thoroughfare across the river must soon be provided east of London Bridge, and we described a week or two since a scheme for a Tower Bridge which is now before Parliament. We believe that the City authorities are pretty nearly convinced that London Bridge must not be meddled with, but their favourite scheme for supplementing it seems to be the making of a subway or new Thames tunnel just east of the Tower. The drawback to this proposal is that it interposes a descent and an ascent, in other words a couple of hills, in the road along which a very heavy traffic might be expected to pass. It is of course essential that whatever the new communication may be it should be free from any toll. The passing of the Toll Bridges Bill will give the East-end of London a claim for consideration in this matter. A million and a half is to be spent to give West and Central London free course over the river, and as one-third of our vast population lives east of London Bridge, it will hardly be possible to deny them a like expenditure to enable them to get across to the other bank without a journey of a mile round. It would seem as though the City and the Metropolitan Board should put aside their jealousies and make the present Bill complete by including in it the needed provision which will give the East what it is now proposed to bestow on the West.

"IRON," *24th February*, 1877.

THE PROPOSED TOWER BRIDGE.—The various propositions for widening, at some risk to its stability, and to the utter destruction of its beauty, the nearest bridge to the sea of the many crossing the Thames, having been definitely abandoned, it may be presumed that the question of the precise position and method of construction of the new bridge which sooner or later must supplement the structure built over the ferry of St. Mary, will excite no little attention in London, and, for that matter, in England. No greater mistake could be made than to suppose that the question is merely local.

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To all intents and purposes, the necessity of relieving the congested traffic which surrounds London Bridge, is a matter not of local but of imperial importance. The immense extension of London to the east and south-east, the growth of the docks, and the vast increase of population and light as well as heavy traffic, demand serious consideration, not only at the hands of the Court of Common Council, but of the public and the Legislature.

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Since the suggestion for widening London Bridge was put forward by Messrs. Horace Jones and Charles Hutton Gregory, several schemes have been advanced for alleviating the traffic without interfering with the existing structure. A tunnel naturally suggested itself as opposing the least obstacle to river traffic, and interfering least with vested rights, and it has been proposed to get over the difficult gradients by a spiral shaft at either side. An hydraulic lift-bridge has also been proposed—so lofty as to enable the tallest masts of vessels coming up to London Bridge to pass under it—and other schemes for high-level bridges have also been brought forward, while a steam-ferry is actually in operation. Besides these, the plan of a double-drawbridge has recently been put forward, as well as that of a rolling bridge. No little engineering skill has been expended on these designs, all of which—as is the nature of things human—leave something to be desired. The prevailing defect of all of them is, that the question of approaches has hardly received sufficient consideration. It is one thing to have a bridge, and another to reach it; and no method of crossing the Pool can be accepted which does not include some great improvement in the communications on both sides of the river.

A bold and original attempt to grasp the difficulty has been made by Mr. E. Brainerd Webb and Mr. James Bolland, whose joint pamphlet has just appeared. These gentlemen point out clearly enough the defects of tunnels, drawbridges, and high-level bridges, and propose to cut the knot by a low-level bridge, adapted not only for ordinary traffic, but for facilitating the railway communication of the two banks of the Thames. Recognising that, to be thoroughly efficient as a deflector of traffic, the new bridge should be at a considerable distance from London Bridge, they suggest that no better site can be found than the space which separates the Tower from the St. Katherine's Dock warehouses—a point admitting of the most satisfactory connections with the main northern thoroughfares. Crossing the river to Horselydown Stairs, the new bridge would, with some rectification of approaches, bring these into communication with the great southern arteries, and thus divert from London Bridge a large proportion of the traffic which now attempts to struggle over it. A glance at the map will show that to the northward the Minories would be brought, at the Mint, into open communication with the proposed bridge, and that through the Minories the traffic of the Commercial and Whitechapel Roads would pass.

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On the south side it is proposed to open a new road from Horselydown to the junction of the Old and New Kent Roads—relieving Tooley Street almost entirely of its present burden.

On the exact width and material of the proposed bridge, Messrs. Webb and Bolland are prudently reticent, but insist that the width should be ample.

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They intimate that sufficient width for roadway and four lines of railway should be provided, and that with a view to the future, a certain space might be set apart for shops—separating the road from the lines of rail—to be subsequently removed when increased accommodation should be needed. The new bridge would have the same height above Trinity high-water mark as London Bridge. Upon the bridge itself the levels of the rails and the road surface would be the same, but in the approaches would considerably differ. Thus, on the north side the "roadway approach would be almost horizontal, as far as the Mint, whilst the railway approach would descend from the bridge along the Tower ditch, with a gradient of 1 in 40. The southern roadway approach, on the contrary, would descend from the bridge, with a gradient of 1 in 40, to the general level of the streets in Horselydown, whilst the railway would retain nearly the bridge level to the junction with the viaduct near London Bridge Station."

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It is impossible to deny that the scheme of Mr. Webb and Mr. Bolland is endowed with a certain grand and seductive comprehensiveness, but we apprehend that their views will on that very account meet with vehement opposition. There is in England a rooted objection to measures of a thorough and sweeping character, and the increasing taste for economy has, if possible, enhanced the national predilection for tinkering and pottering about in preference to accepting an inevitable responsibility and discharging it completely. But the advocates of the low-level bridge at the Tower will have to meet opposition other than that of mere *vis inertiæ.* By attempting to cut off the ascent of masted vessels at the Tower they will raise the demon of Vested Interests in all his might, and we tremble at the amount of compensation which the wharfingers will feel themselves legitimately entitled to.

"THE ARCHITECT," *February 24th*, 1877.

FREE BRIDGES FOR LONDON.—London is here to be regarded as a vast commercial town with a river running through it. On one side of the river there are, let us say, a million of residents, and on the other side three millions. These are of course large figures, so large indeed that it is easy enough to imagine the one side and its population being wholly separated from the other side and its population in everything, or nearly everything, that constitutes commonplace daily business. If the river were an arm of the sea as at New York, or a wide estuary as at Liverpool, there would be two towns in the case instead of only two parts of one. But the River Thames is comparatively narrow, and the communication across it is not a question of ferry-boats, but only one of ordinary bridges. Accordingly, the intercourse between the Middlesex side and the Surrey side is most intimate, and the traffic continual, so that the river has long ceased to be anything more in this view of the case than an impediment to passengers.

In such circumstances one might be excused for assuming that by this time the public authorities have carried their leading thoroughfares across the river at all available points, so as to enable the people to find their way almost if not altogether as freely and as conveniently from one point of London to another across the water as they do across the land. It does not require much argument to satisfy either intellect or instinct that, unless this is so, the river must be so far a preposterous anachronism.

Now it is nothing new to suggest that it has been the practice of English people for a very long time back to be a great deal too parsimonious in respect of public works. One might almost say, looking at ancient building operations as compared with modern, that the more wealthy we have become—and we have now become very wealthy indeed—the less liberality we have displayed. At any rate, amongst other singular aberrations of judgment, we seem to have somehow accepted the principle, with regard to bridging the London river, that the public cash ought not to be laid out in that direction as an indispensable expenditure for the public benefit, but that proprietary bodies in some form or other ought to be allowed to raise the money as a speculation, and take what profit they could out of it. It does not appear to have occurred to those who dictated this course that one of two evils must almost necessarily result; either the speculators must make an undue profit at the expense of the public, or they make a loss without benefit to the public; neither of these being at all desirable. However, the system of building public bridges by speculative enterprise, as it may be gracefully designated, has been the cause of much embarrassment. In fact the very sight of a tollgate mars the whole undertaking. The more unreasoning classes of the people regard the otherwise inviting thoroughfares from the first as forbidden ground, if not as traps for the small money of the poor; so much so that at this moment a waggoner will consent to make a considerable circuit to cross Westminster Bridge instead of Waterloo, and thus to save sixpence in coin at the cost of a good five shillings in horse-flesh. On the other hand, whilst the tolls in themselves are thus made but scantily productive, the cost of collection is but too considerable. It may even be alleged generally, amongst a score of other inconveniences, that the popular mind has been led to look upon Waterloo or Vauxhall Bridge, not as a convenience at all, but rather as a monument of ingenious oppression, erected for the purpose of obstructing under false pretences our transit over our own river, humbling our pride before the keepers of turnpike gates, and compelling us in a sort of derision to pay pennies and twopences for nothing at all.

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One result which can scarcely fail to appear in due time will be a demand for more bridges. Hitherto, as we have ventured to suggest, the river has been looked upon as an obstruction of nature indirectly fortified by the imperfect arrangements of art; and the circumscribed accommodation afforded by the bridges may be said to have been taken with a timorous thankfulness as being at all events better than nothing. Now, however, the ribbon of water which runs through London will come to be presently regarded as an accident of trifling moment, and the question of carrying the traffic over it will be treated boldly, and the demands of various local interests expressed loudly; so much so that we need not feel any surprise if the next generation of engineers should be found to question the necessity for such a town as London being embarrassed with a river at all, except here and there for the sake of artistic effect where a little space can be spared. That new bridges will bring about new thoroughfares need scarcely be said. The Metropolitan Board of Works will be no longer barred by the river when setting out their schemes of grand new lines of traffic, and the claims of "the Surrey side" as a harmless if helpless adjunct of the real London will disapear in the more imposing idea that two great towns have now been thrown into one and their old-world separation by a mere stream of water for ever ignored.

"Daily Telegraph," *27th February*, 1877.

After tedious discussions in the Common Council, extending over a quarter of a century, on the expediency of relieving the congested traffic on London Bridge, it may at length be accepted as a foregone conclusion that a practical solution of the vexed question will soon be reached. The necessity for supplementing the present inadequate means of transit for foot passengers and vehicles across the Thames on the east side of the metropolis is felt by the public to be so urgent that if the

Corporation should further postpone the adoption of measures to remedy the existing inconveniences, the enterprise is likely to pass into private hands. London Bridge is situated on the central line between the east and west boundaries of the metropolis. To the west of that line there are fourteen bridges, including the West London Railway Bridge above Battersea, to meet the requirements of sixty-two square miles of metropolitan area. The entire accommodation provided for sixty square miles of area lying to the east of London, however, only consists of the small footway tunnel near the Tower, and the Thames Tunnel, both of which are capable of taking a very inconsiderable portion of the traffic in that direction. On the supposition, therefore, that all of these bridges are equally adapted for the public service, and bear their fair share of traffic, the duty now exacted in that proportion from London Bridge is eight times what is performed by any one of the others. It is estimated by Mr. William Haywood, an eminent authority on this subject, that there is a daily average of 19,400 carriages crossing London Bridge; and from another source we learn that the average number of foot-passengers amounts to upwards of 105,000 per diem. When the proposal to build a new bridge was submitted to the Common Council in 1852, it was stated that the loss sustained at that period by the stoppage of conveyances owing to the chronic "block" of traffic in the streets was almost sufficient to meet the cost of a new bridge erected once a year. Nor does the dense confusion of animals and vehicles still visible every working day at the junction of King William, Cannon, and Gracechurch Streets give any sign of the former chaos being reduced to order. Criticism of the scheme for widening the fine structure of Sir John Rennie, which some time ago appeared to find favour with the City authorities, is now happily rendered superfluous, for that plan has been deliberately set aside by a majority of the Common Council, as well as condemned by the mass of the citizens.

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Moreover, the widening of the bridge would fail to afford the increased accommodation required for the traffic without a corresponding enlargement of the approaches at each end; but the expenditure entailed by that change would almost equal the expense which the erection of a new bridge would involve.

The Special Bridge and Subway Committee have lately recommended that a bridge or subway should be constructed from Little Tower Hill and Irongate Stairs on the north side, communicating with Horselydown Lane and Stairs on the south side. We may summarily dismiss the tunnel, hydraulic-lift bridge, and steam-ferry schemes. They may be useful as leading appliances for relieving the existing pressure of traffic; but it is the opinion of the most competent engineers that a bridge of dimensions framed in anticipation of augmenting business will alone meet the requirements of the case.

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Owners of wharves between London Bridge and the site of the proposed new structure will naturally object to any public improvement which tends to the depreciation of their property.

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Private claims, however, must eventually yield to considerations of public utility, while just compensation should be made to holders of river property who may suffer by the proposed undertaking. Still the extent to which a bridge thrown across the Thames at the point we have mentioned would interfere with the business of wharfingers has been needlessly exaggerated.

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The total number of vessels passing up the river westward of St. Katherine's Dock in the six consecutive working days of a given week was found by the Subway Committee to be one hundred and forty-four.

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The approach, which may be said to be already formed, leading to the contemplated new structure on the north, would lie between the east end of the Tower and the western wall of St. Katherine's Docks, and an uninterrupted thoroughfare could without difficulty be created thence through the Minories to Whitechapel Road. The southern approach, under any circumstances, would extend to Bermondsey by a straight line from the junction of the New and Old Kent Roads with Great Dover Street. A direct path would thus be secured between Shoreditch and the Old Kent Road, and the entire traffic lying to the north-east and south-west of the City, including the heavy dock traffic, would cross the river by that route. Fortunately good gradients can be obtained with ease, and incalculable advantage would result from the bridge, especially to those interested in the swelling volume of trade in movement across the river between the regions of the metropolis we have specified.

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No estimate of the total cost of the project has yet been arrived at, though it cannot fail to be great, the chief item being the compensation demanded by wharfingers. So far, however, from this being an apology for delay, it is an argument for immediate action, since the value of property and the price of labour and materials are certain to increase. Indeed, present expense is of secondary moment; the development of the plan on a broad and comprehensive scale suitable to the wants of coming generations is the true economy. The precise width of the new structure has not yet, of course, been decided upon; but Messrs. Webb and Bolland, in an elaborate pamphlet which they have just issued, suggest that sufficient breadth for a roadway and lines of railway, communicating with existing railway systems north and south, should be provided. Yet, however intrinsically practicable such a conception may be, it is not improbable that it might be deemed Utopian by the multitude, who cannot be expected to realise so vividly the exigencies of the remote future as the enthusiastic authors. Certain it is that London has made stupendous strides in commerce during the last three hundred years.

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Even now our means of transpontine communication are immeasurably inferior to those of great Continental cities.

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The public anxiously await definite steps to be taken by the Corporation to meet the imperative necessities of the situation. It would not be creditable that the City authorities should be forestalled by private speculation in the matter. If the bridge were the property of a joint-stock company, tolls would be levied, and a burden of that description is not again to be tolerated on London bridges. The work should be executed at public expense, and be worthy of the vast and powerful constituency to whose convenience it is designed to minister.

"City Press," *17th March*, 1877.

A report with reference to the interminable "Bridge Question," adopted on Monday last at the meeting of the Whitechapel Board of Works, does not add anything to the information upon the subject which our readers already possess, but it helps to keep alive a question which is of daily-increasing importance. The report gives the result of conferences held between a committee of the above-named Board and representatives attending from the vestries of St. George-in-the-East and Rotherhithe and District Boards of Limehouse and St. Olave, Southwark, and of citizens within Portsoken Ward, with regard to providing a communication between the north and south sides of the Thames, below London Bridge. After detailing what has been done, or attempted to be done, in the matter, the report goes on to say that "It has been a frequently-expressed hope at meetings of the representatives that some unity of action between the Metropolitan Board as the representatives of the metropolis and the Court of Common Council as representing the City could be agreed upon with regard to the proposed and much needed communication. The action of the Court of Common Council is, in some measure, circumscribed by the consideration from whence the funds are to be obtained, and may, perhaps, be in some measure influenced by the fact that the necessity can be met effectually only by operations to be carried on outside the limits of the City boundaries. Neither consideration need influence the action of the Metropolitan Board, and the joint action of the two bodies might effect all that can be desired. The delegates add one recommendation, namely, that as, in their opinion, the matter is one of vast importance to the public, the local authorities should, either by combination or separately, as may be deemed the better, embrace the present favourable opportunity to use their utmost endeavours to procure the performance of a work so necessary as the construction of an efficient bridge over or subway under the Thames, which would afford an advantage to the general public far beyond the freeing from toll most of the existing toll-bridges of the Thames."

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WAITING FOR THE FLOOD.